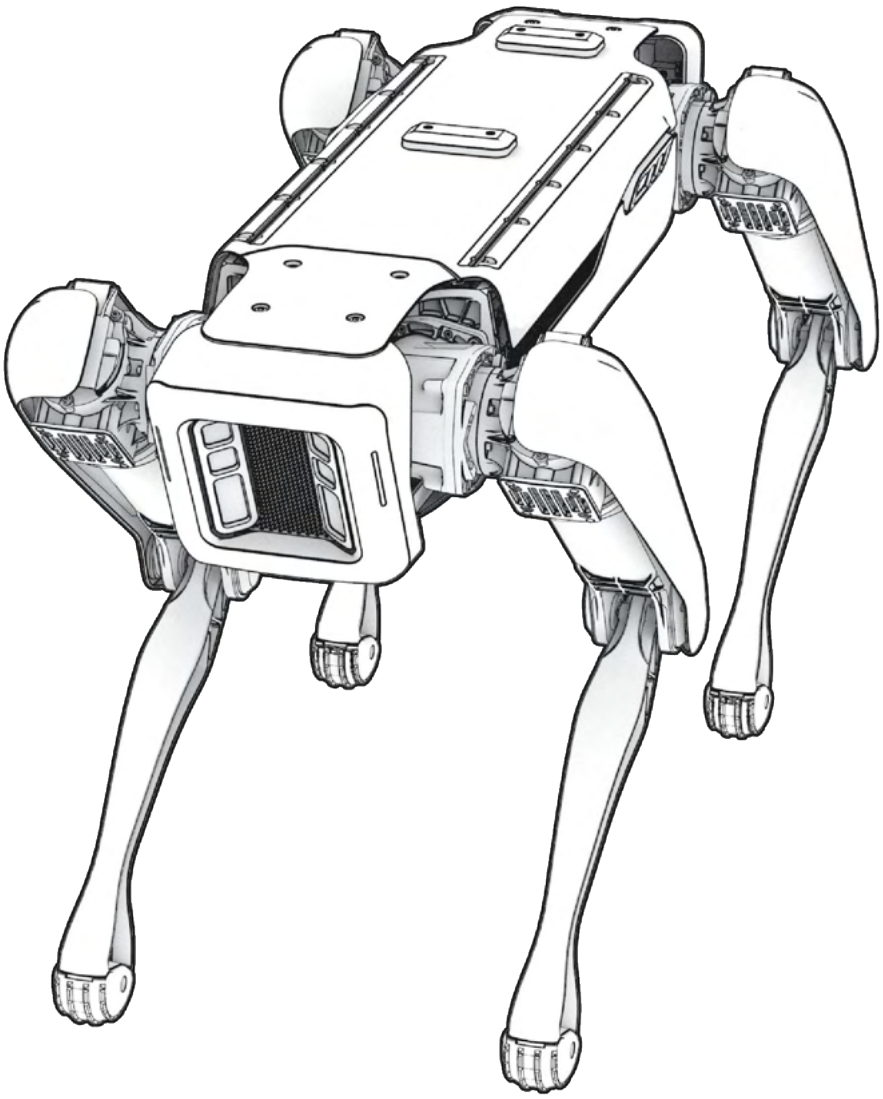
Boston Dynamics

Spot® Instructions for Use

Safety and Operations Manual

Version 2.0 Original Instructions
September 2023



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1. Introduction

1.1. About this document

This document contains critical safety information for the Spot robot.

Responsible use of Spot is crucial to prevent dangerous conditions for those in close proximity to Spot. Read, understand, and comply with this document before initial use of Spot to decrease the risk of injuries or damage to yourself, Spot, or other property.

Spot is a partly completed machinery (as defined in Directive 2006/42/EC Art. 2(g), valid in the E.U.) and each integration of Spot in a final application requires a dedicated risk assessment. See 2.1: General principles and complete a risk assessment and evaluation of the intended application of Spot before powering it up and commissioning it into a solution. The commissioning party should compile additional Information for Use specific to the final application, including limitations and intended use.

Keep a copy of this document in a readily accessible location. Complete user and developer documentation on the Spot robot platform, including a digital version of this document, is available online in the Boston Dynamics Support Center (see 8: Appendix A: Supplemental information).

This document is valid for the following designation of Spot:

Hardware	04-00143531-001 (model number)
Software	v3.3 and above

1.2. Manufacturer information

Spot is manufactured by:

Boston Dynamics, Inc.
200 Smith St.
Waltham, MA 02451
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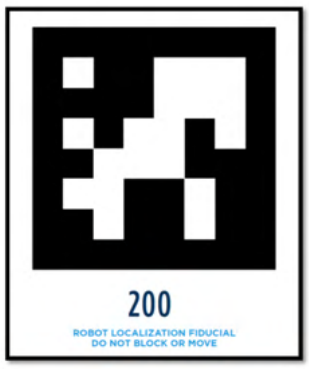
1.3. Key terminology

Term	Definition	
Spot	A legged robot capable of mobility on a variety of terrains. Spot uses multiple sensors and three motors in each leg to navigate in indoor and outdoor environments, maintain balance and attain postures. Spot is capable of carrying and powering attachments.	
Operator	Any person trained and authorized to manually operate, repair, handle, or supervise the automatic operation of Spot. This definition corresponds to the terms “Qualified person” and “Authorized person” as defined in ISO/TR 22053:2021, Clause 3.4.	
Bystander	Any person who can be reasonably expected to be near Spot, but is not an Operator. This definition corresponds to the term “Affected person” as defined in ANSI B11.0-2020, Clause 3.4.	
Task	An activity performed by a person, including manual operation of Spot.	
Operation	An activity performed by Spot, whether as a result of manual or automatic operation.	
Mission	A set of instructions and map data that allows Spot to navigate automatically along a known route while performing data capture actions and other operations. The features that allow Spot to record and replay missions are collectively called “Autowalk”.	
Action	A predefined operation that can be performed during a mission. The Spot software includes several preset Actions, such as capturing images from robot cameras and docking with a Spot Dock. Custom Actions can be created using Spot’s software development tools.	
Attachment	Any device or piece of hardware that is affixed to Spot to enhance or expand Spot’s functionality. Attachments for Spot are commonly called “payloads”.	
Fiducials		Specially designed images similar to QR codes that Spot uses to match its internal map to the world around it. Fiducials are required at the beginning of every mission. Spot recognizes AprilTag fiducials that meet the following requirements: • AprilTags in the Tag36h11 set. • The default Image size: 146 mm square. • Printed on white non-glossy U.S. letter-size sheets (preferably rigid).

1.3.1. Legend of hazard labels

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

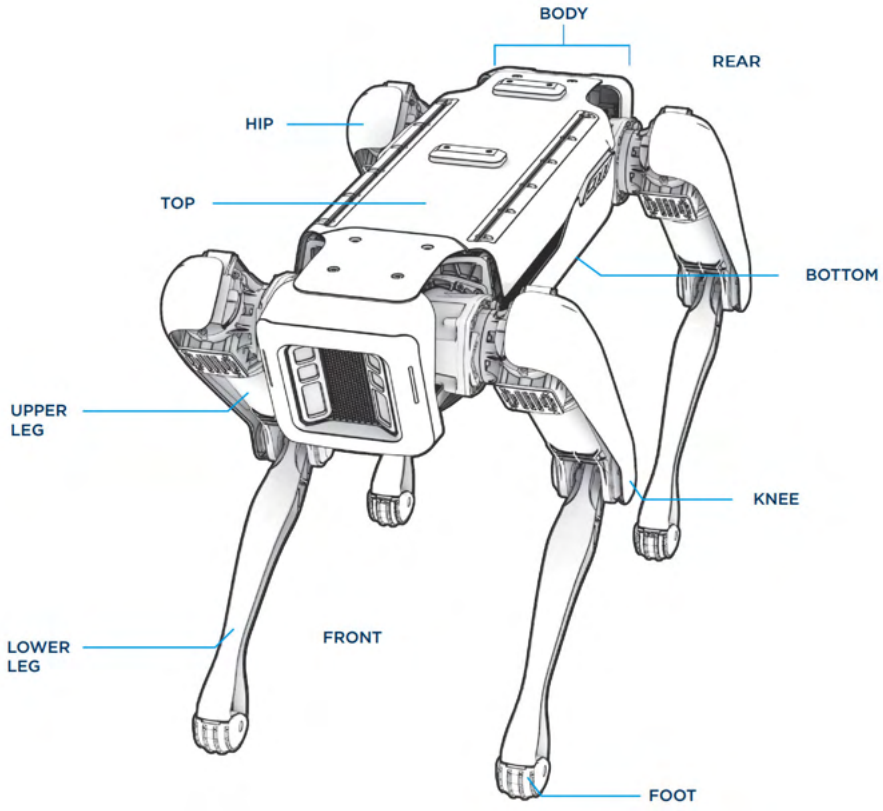
NOTICE

Indicates information considered important, but not hazard related.

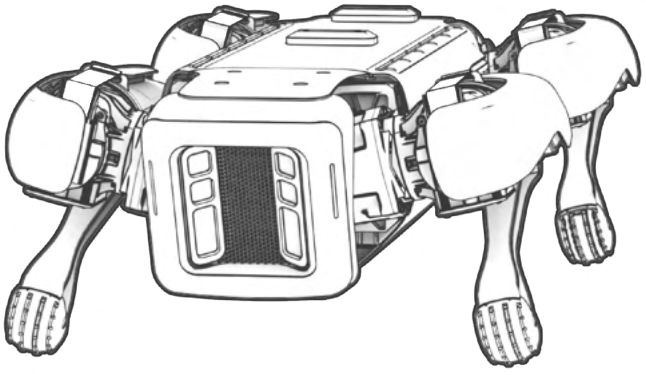
REQUIRED READING

Indicates a mandatory reading of Instructions for Use or other safety-related documentation.

1.3.2. Spot anatomy



Spot in the "stand" pose.



Spot in the "sit" pose.

1.4. Spot specifications

Category	Specification	Value	
Dimensions	Length	1100 mm	
	Width	500 mm	
	Default height (walking)	610 mm	
	Height (sitting)	191 mm	
	Max height (walking)	700 mm	
	Min height (walking)	520 mm	
	Net mass/weight (with Battery)	32.7 kg	
	Degrees of freedom	12	
	Max speed[1]	1.6 m/s	
Power	Battery capacity	564 Wh	
	Max battery voltage	58.8 V	
	Typical runtime	90 minutes	
	Standby time (Spot powered, motors off)	180 minutes	
	Spot Power Supply power output	400 W	
	Max charge current	7 A	
	Time to charge (Spot Dock ambient temp. 25°C)	Approximately 50 minutes for 80% charge	Approximately 2 hours for 100% charge
	Time to charge (Spot Dock ambient temp. 35°C)	Approximately 2.5 hours for 80% charge	Approximately 3.5 hours for 100% charge
	Time to charge (Spot Power Supply)	Approximately 1 hour	
	Battery mass/weight	5.2 kg	

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Category	Specification	Value
Cameras	Camera functions	Black-and-white or color fisheye, range (depth), infrared
	Number of optical cameras(for image capture, fiducial recognition, displaying surroundings)	5 (front-left, front-right, left, right, rear)
	Overall optical field of view (FOV)	360 degrees
	Number of depth cameras (for robot perception, obstacle avoidance)	5 stereo pairs (front-left, front-right, left, right, rear)
	Overall depth camera field of view (FOV)	Approximately 90 degrees in each direction[2]
	Depth camera range	~2 m
Attachments	Max weight	14 kg
	Max power per port	150 W
	Payload ports	2 (mirrored)
	T-slot rail bolt size	M5 x 1.0
Connectivity	Enterprise WiFi	2.4Ghz and 5Ghz 802.11b/g/n and 802.11ac
	Ethernet	1000Base-T

[1]Max speed is determined against nominal environmental/navigational conditions. See 2.8: Restrictions on the environment.

[2]There are gaps near the hips where the depth camera field of view does not overlap. See 2.7: Obstacle avoidance.

2. Product safety overview

2.1. General principles

Spot is a legged robot capable of mobility on a variety of terrains. Spot uses multiple sensors and three motors in each leg to navigate in indoor and outdoor environments, maintain balance and attain postures. Spot is capable of carrying and powering attachments.

CAUTION

Spot's behavior while in motion is dynamic and can be subject to local conditions that may generate unexpected motion.

2.2. Intended use

Spot is intended for professional use in either industrial or restricted or controlled environments. Spot is typically commissioned in a final solution in dedicated areas where access is subject to restrictions specified with the solution.

The Instructions for Use for the final solution (not this document) shall indicate those conditions.

Spot is not intended for uses involving concurrent human-robot activities sharing the same space or the same equipment to complete an assigned task/mission (sometimes known as "collaborative applications"). People can be occasionally present in the same space as Spot for purposes unrelated to Spot operations (see "Bystander" in 1.3: Key terminology).

Spot is a general-purpose robot that provides advanced mobility. Specific uses are built on top of mobility by custom-defined applications (including interactive or collaborative ones).

You must complete a risk assessment of such applications and any aspect that may be different from the generic intended use described above.

NOTICE

Spot can carry attachments that narrow the integration of Spot into a specific application or intended use. An attachment (or Spot behavior determined by attachments) could result in additional hazards or different risks with respect to the generic use of Spot.

Risk assessment for applications should consider reasonably foreseeable misuses. Explicitly prohibited uses include, but are not limited to:

- Use without performing a risk assessment.
- Underwater and airborne applications.
- Military use.

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- Any use as – or enabling the use of – a Certified Medical Device. Access and operation in healthcare facilities subject to limitations.
- Use in personal care, medical treatment or life-critical applications.
- Use in home environments.
- Transportation of persons or animals.
- Transportation of hazardous materials or substances.
- Intentionally harming any person with Spot or by using attachments mounted on Spot.
- Use for any illegal purpose.
- Use as a climbing aid.
- Interfering with Spot's sensors so as to impair their functioning, intentionally altering the environmental conditions so as to impair the functioning of Spot's sensors, or intentionally altering the environmental conditions so as to impair Spot's locomotion.

DANGER

Any misuse of Spot can potentially cause severe personal injuries or result in significant material hazards.

The risk assessment shall consider the entire lifecycle of the Spot application, including but not limited to:

- Setting up and commissioning, with particular attention to training activities.
- Regular use, with particular attention to navigation operations.
- Maintenance and troubleshooting.

2.3. Modes of operation

Spot can be operated in various modes.

- Manual: Direct operation of Spot by displaying images from Spot's cameras on a remote controller. See 5.2: Remote controllers and 5.7: Driving with remote control.
- Automatic: Autowalk missions can be recorded and replayed by Spot. During replay Spot operates automatically. See 5.8: Automatic operation.

CAUTION

Spot should always be remotely controlled by properly trained Operators, or execute automatic operations configured or programmed by a trained professional.

Failure to properly verify programmed applications may result in unexpected hazard during operations.

The frequency and duration of Spot operations in either manual or automatic modes varies greatly depending on the final application Spot is used for.

For example, applications including routine inspections of industrial assets can be configured along a route in manual mode and then be repeated and completed largely in automatic mode. While operating in automatic mode, Spot is expected to encounter bystanders not involved in its operations for very brief moments along routes. While operating in manual mode, interactions with bystanders are expected to be longer, although limited in time, and may include people attending to their own tasks in the operating environment.

A complete analysis (see 2.9: Risk assessment) of foreseeable exposure to Spot must be done before commissioning any final application.

2.4. Locomotion primitives: gaits and specialized modes

2.4.1. Walk (“trot”)

Spot’s default gait. Spot moves at variable speed on alternating pairs of legs (front-right/hind-left, front-left/hind-right).

2.4.2. Crawl

Spot moves slower than trot on flat terrain and keeps three feet on the ground at all times.

2.4.3. Quick-step slip prevention

In the Walk gait, Spot may take extremely rapid steps while recovering from a slip. This greatly reduces the chance of falls on ice, wet or oily floors, and other slippery surfaces.

2.4.4. Stair mode

During both manual and automatic operations, when Spot detects a stairway in its path, it will automatically adjust its gait to a moderate speed and pitch its body to adjust to the slope of the stairway. Spot will automatically align itself with the center of the stairway to avoid colliding with walls or railings.

Stair locomotion involves sophisticated control and use of sensors. For the best and most reliable performance in these conditions, keep Spot’s software fully updated.

Failures on stairs cannot be completely eliminated. When using Spot in manual mode, the best results are obtained when operators do not interfere with the automatic stair behavior by suspending, altering, or making rapid changes in manual commands. Actively stopping Spot on stairs has negative effects on stability (see 2.9.6.3: Hazards associated with stopping or other powerless motion).

For more information about driving Spot on stairs, see 5.9: Navigating stairs.

2.5. Stopping functions

2.5.1. Operational stop

Spot monitors its sensors and can automatically pause movement or remove power from motors in certain situations:

- Signal loss: After 3 seconds without controller communication, Spot will sit. After 8 seconds without communication, Spot will turn off its motors. See 5.2.3: Enabling AutoReturn to recover from loss of connection to the controller and 5.8.4: Autowalk replay supervision.
- Fall detection: When Spot detects a fall, motors are immediately de-energized. Legs will not actively flail or remain stiff under contact.
- Low battery: When Spot's batteries reach critically low levels, Spot will sit and turn off its motors.
- Controller input: Commands to stop or de-energize Spot can be sent from a robot control device. See 5.2: Remote controllers and 5.4: Stopping Spot.

WARNING

If Spot is on stairs when an operational stop would occur, it will attempt to exit the staircase before performing the operational stop. This may result in automatic locomotion up or down the staircase, overriding other locomotion commands.

Do not stand on stairs, below open rails, or within 2 meters of the bottom of a staircase where Spot is active.

NOTICE

Spot can detect falls that unexpectedly occur. De-energization of legs during falls minimizes damage from the fall and prevents new hazards or bigger risks, such as further stumbling. This behavior is called "smart freeze."

2.5.2. Safety-related stop

Spot can be stopped by interfacing an external safe input signal to the payload port.

The stopping function will result in a de-energization of all motors (Stop Cat. 0 EN IEC 60204-1).

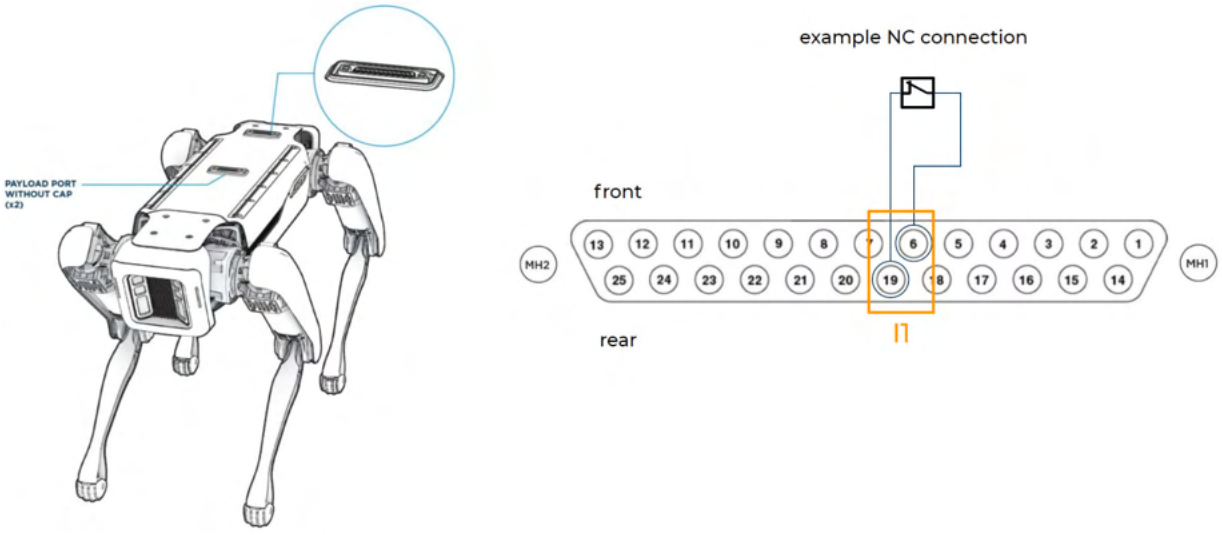
WARNING

When motors are de-energized, Spot will lose its ability to stand and balance. On flat ground, Spot will lower its body. On inclined surfaces or stairs, Spot may tip over.

The maximum response time for the stopping function is 200 ms.

Safe inputs for activating and triggering the stopping function are located on the payload ports as follows:

Item	Description
Safe input location (See figure below)	I1 = pin 19
Interface	Use only one port, either front or rear. See example in figure below. Spot will not work without a cap or a properly configured attachment connected to each port. When a cap is used, the stopping function is disabled.
Safe input default connection	6-19 pair normally closed (NC).
Type of stop	Stop Category 0 (IEC 60204-1) when contact on I1 is opened.
Stopping safety function	Implemented in accordance with ISO 13849-1:2016, of Category 1 and performance level c. The PFHD is 1.1E-6/hr.
Reset	6-19 pair is closed.
Restart	Enable power following commands on the manual controller or issued from programs.
Environment	The safety-related part of the control system operates within the same environment limits established for Spot.



Payload port external signal interface for protective stop.

WARNING

Use safety-related inputs only for connection to safeguards or emergency stop devices. Do not interface with non safety-related signals.

2.5.2.1. Stopping distance

On flat ground, a safety-related stop will result in a maximum stopping distance of 1 meter. On uneven or sloped surfaces, the stopping distance could be augmented by Spot's motion under gravity and will depend on factors such as the slope or unevenness of the walking surface. For more information, see 2.9.6.3: Hazards associated with stopping or other powerless motion.

2.5.3. Emergency stop

Spot can be optionally fitted with any Emergency Stop device that complies with ISO 13850 to implement an Emergency Stop function, using the built-in 2.5.2: Safety-related stop.

The Emergency Stop input device must meet the requirements of the safe input interface on the payload port.

The Emergency Stop function is NOT a primary protective measure in any situation, and is manually activated. It should be used only when an immediate emergency cannot otherwise be resolved, for instance in case of accidental entrapment or insufficient clearances.

WARNING

The Emergency Stop function must be used only when you have full visibility of Spot and its surroundings. A manually activated Emergency Stop will override any active control, and therefore could determine additional hazards if it causes a forced loss of stability (see also 2.9.6.3: Hazards associated with stopping or other powerless motion).

CAUTION

Always try to anticipate and escape entrapment conditions.

Do not activate the Emergency Stop function for routine interventions or as a means for a normal stop.

Spot will not resume operations until a deliberate reset and restart procedure is initiated.

2.6. Velocity limitation

When operating Spot manually in the Walk gait, Spot's maximum speed is adjustable up to 1.6 m/s. To switch between the following maximum speed settings, see 5.7.1: Tablet controls (Drive mode).

Speed setting	Velocity
Fast	1.6 m/s

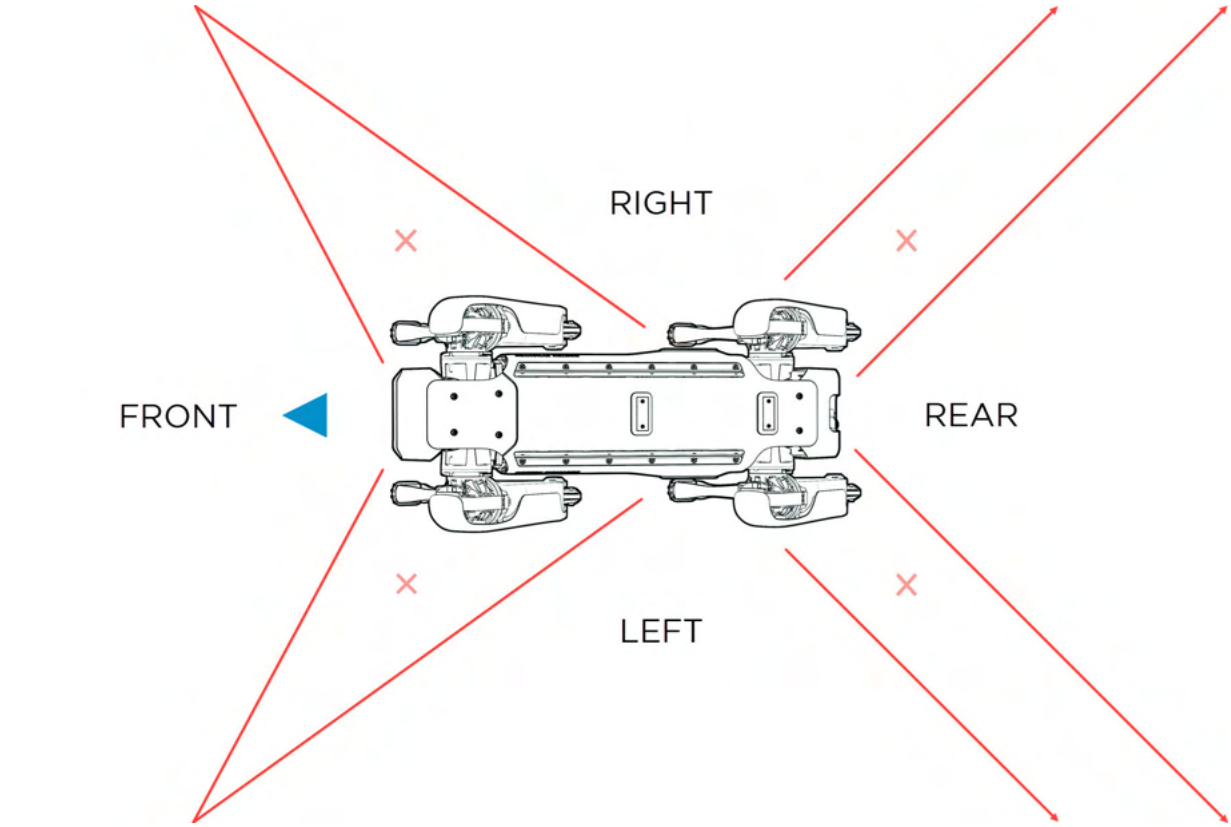
Speed setting	Velocity
Med (default)	0.9 m/s
Slow	0.5 m/s

2.7. Obstacle avoidance

Spot uses its perception system to automatically avoid collisions with obstacles. The perception system consists of five depth cameras: two at the front, one at the rear, and one on each side of Spot.

NOTICE

Although the camera images displayed to an operator may show an overlapping field of view, the perception system has gaps, especially at the rear corners of Spot.



Approximation of gaps in the obstacle avoidance field of view.

Obstacles are mapped and remembered even when Spot's movement brings the obstacle into one of the gaps. However, Spot may fail to detect:

- Moving obstacles.

- Obstacles that are hard to detect until Spot is very close. (For details on the limits of the perception system, refer to 2.8.2: Navigational conditions.)
- Obstacles that remain in a gap in Spot's field of view during its entire approach path.

By default, Spot tries to keep a minimum distance of about 7.5 cm between itself and nearby obstacles. You can set an additional cushion of up to 50 cm using the controls described in 5.7: Driving with remote control. The obstacle avoidance cushion may prevent Spot from traversing doorways and other confined spaces.

CAUTION

Spot may collide with people or objects, even with its obstacle detection system enabled.

Operators and bystanders should assume that Spot may move unexpectedly at any time.

2.8. Restrictions on the environment

Spot is designed for dynamic mobility in a variety of environments and terrains. The following tables describe the nominal environmental conditions in which Spot is expected to work as intended. Spot is assumed to be in like-new condition with no attachments or other modifications.

The listed environmental constraints are treated as independent variables, but will intersect in real-world conditions. For instance, assume Spot is operated on a sloped surface that is also covered in debris. Even if the slope and the debris are each within nominal tolerances, Spot's performance may degrade in ways that would not happen if the same slope was uncluttered or if the debris was on flat ground.

A risk assessment must always identify the environmental conditions for a particular application of Spot and estimate any risk change associated with operating in non-nominal conditions.

2.8.1. Environmental conditions

Environment	Nominal conditions
Surface	• Minimum coefficient of friction: 0.4 • Debris and/or uneven surfaces: height variations up to 25 cm • Avoid soft or pliable surfaces: minimum force 8 kN/m.
Space	• Minimum height of obstacles overhanging the walking surface: 70 cm • Minimum doorway, gap, or corridor width (forward/reverse direction of travel): 60 cm • Minimum space to turn around (rotate in place): 122 cm x 122 cm
Slopes	• Maximum pitch: +/- 30 degrees

Environment	Nominal conditions
Elevated Ground	• Maximum height of negative obstacles (step up or down): 35 cm • Stable (unmoving) surfaces: less than 5 cm lateral motion
Stairways	• Minimum width: 64 cm • Maximum pitch: +/- 45 degrees • Maximum step height: 22 cm • Barriers at least 50 cm high at the sides, with gaps no more than 30 cm wide. • Straight direction of travel (no curvature or turns except on flat landings). • Minimum landing size (90-degree turn): 112 cm x 112 cm • Minimum landing size (180-degree turn): 97 cm x 226 cm • Minimum landing size (no turn): 64 cm x 107 cm • Free space in front of top or bottom of stairs: 112 cm x 112 cm
Lighting	• Dynamic range of ambient light: 68 dB • Minimum ambient light for clear visuals from robot cameras: 50 lux • High-contrast light that includes IR wavelengths (e.g. sunlight) may interfere with obstacle detection.
Climate/ Ingress	• Ingress protection: IP54 • Ambient temperature range for operation: -20°C to 45°C • Maximum non-condensing humidity: 99% relative humidity

When performing a risk assessment for your Spot application, consider that any deviation from the nominal environmental conditions (Surface, Space, Slopes, Elevated Ground, Stairways) may increase the occurrence of total or partial loss of stability (see 2.9.6: Unintended contact and other hazards related to locomotion). Effects of instability may include, but are not limited to:

- Falls
- Erratic movements for regaining balance
- Inability to proceed with locomotion

Exceeding the Climate/Ingress conditions may have a significant effect on the reliability of Spot hardware:

- Extreme temperatures or submersion in water may cause failures in various Spot components dedicated to perception and control (cameras, joints, CPU, etc.)
- Quick transitions (“thermal shock”) may cause condensation on internal components, leading over time to corrosion.
- Intermittent, but frequent, exceeding of temperature or ingress limits may lead to latent damages that are not immediately visible but can originate failures over time.

2.8.2. Navigational conditions

Category	Spot capabilities/conditions
Obstacle sensing ranges/limitations	• Camera sensing range: ~2 m • Although the camera images on the tablet controller show an overlapping field of view, the perception system has gaps, especially at the rear corners of Spot. • Cannot detect obstacles directly above Spot (e.g. if Spot is sitting under a table and then attempts to stand, the top of Spot will hit the table).
Obstacle height	• Objects shorter than 30 cm: Spot will attempt to step on or over the obstacle. • Objects taller than 30 cm: Spot will attempt to avoid the obstacle.
Obstacle area/ width	• Minimum area/width: 3 cm
Surfaces that interfere with navigation	• Reflective (mirrored) surfaces • Transparent objects/barriers • Under bright ambient light or dark matte surfaces • Repeating patterns of vertical lines
Energy sources that interfere with navigation	• Near-IR (780-2500 nm) light sources pointed at Spot or its surroundings. • High-contrast light that includes IR wavelengths (e.g. sunlight).

When performing a risk assessment for your Spot application, consider that any deviation from the nominal navigational conditions may:

- Increase the occurrence of failures in obstacle detection and avoidance.
- Impair Spot's ability to recognize features and fiducials.
- Impair Spot's ability to complete navigation as planned.

2.9. Risk assessment

Boston Dynamics has analyzed and reduced risks whenever possible and practicable with our limited knowledge about foreseeable specific applications.

Risks are the transformation of potential hazards into actual harms. To estimate risks it is necessary to combine a measure of:

- The severity of the effect of hazards.
- The occurrence of hazards (how often, how likely, how predictably, how well-anticipated).

Refer to ISO 12100 for the general methodology of risk assessment.

2.9.1. Before starting

You must complete your own risk assessment according to your knowledge of the application, considering:

1. **Intended use**: The set of specific uses (possibly different from the generic one) that determine robot operations, layout, and potential situations for people exposed to Spot.
2. **Foreseeable misuse**: Anything that does not pertain to the intended use and appears as a form of misconduct. The occurrence of misuses can be estimated to be less likely than intended uses.
3. **Non-task-based interactions**: People can be close to Spot as a mere result of sharing the same facility. The occurrence of unrelated interactions is uncommon, infrequent, typically not permanent, and rarely known in advance.
4. Role and type of **personnel**.
    a. *Affected*: People can be occasionally present in the same space as Spot for purposes unrelated to Spot operations. This is the most generic class of exposed people.
    b. *Qualified*: People assigned to operate Spot (e.g. programming missions, occasional manual driving). The frequency of these tasks depends on the application. Spot is commonly dedicated to automatic operations.
5. **Environment of operation**: Every aspect of the actual space where Spot operates must be analyzed with respect to the generic conditions specified in 2.8: Restrictions on the environment. The final environment of Spot applications can significantly alter the conditions for the severity of hazards and alter (normally worsen) the probability of occurrence of failures or hazardous conditions. Important elements for the assessment of the environment include:
    a. *Surfaces*: Material, texture, friction, stiffness, presence of contaminants or dirt or particles, etc., on walking surfaces.
    b. *Spaces*: Layout, areas open to access.
    c. *Slopes*: Length, inclination, material.
    d. *Elevated grounds*: Highest points reachable with respect to ground levels.
    e. *Stairways*: Type, run/rise dimensions, type of risers and treads, handrails, wear conditions, presence of landings, frequency of sharing with personnel.
    f. *Lighting*: Diffuse ambient, collimated, visible/infrared.
    g. *Climate*: Temperature and humidity, presence of condensation.
    h. *Obstacles*: Size, shape, clusters of objects and their stability, free space over and under obstacles, firmness of objects.

NOTICE

Spot can walk over objects.

2.9.2. Electrical hazards

Spot uses a separated extra low-voltage (SELV) power supply design (<60 VDC), meeting the requirements in IEC 60204-1 for electrical equipment and IEC 62133 for batteries. There are no known significant residual risks associated with shocks, either apparent or as a result of faults.

CAUTION

Do not touch or operate Spot if any damage is noticed and wet parts of the body are exposed to contact.

Contact Boston Dynamics Support in case of apparent damage of parts.

You must survey the operating environment at commissioning time to identify potential sources of damaging elements that may compromise the original SELV design:

- Presence of high voltage equipment that may be in range of any physical contact with Spot.
- Presence of potential low impedance paths, for example due to contaminants or low-conductance materials, when in contact with high-voltage equipment.
- Presence of apparent faults or very likely malfunctions in any electrical equipment that Spot may interact with. Report such conditions immediately to management.

WARNING

Exposure to severe electrical and electromagnetic environments may determine non-apparent damages or latent failures of Spot. Using Spot after exposure to high voltage or indirect contact may result in unexpected failure of the electrical system.

High voltage in the environment increases the otherwise negligible probability of accidental shocks, and non-SELV conditions may become possible.

2.9.2.1. Charging equipment

Spot uses a series of approved accessories for charging.

The risk assessment must consider the location and type of connection of charging components in any given application environment. In particular, you must review all possible causes of loss of isolation from the mains.

REQUIRED READING

When assessing risks related to charging equipment, review the following documents in the Boston Dynamics Support Center (see 8: Appendix A: Supplemental information):

- *Spot Power Supply Information for Use*
- *Spot Dock Information for Use*

2.9.3. Hazards due to non-ionizing radiation

Spot has no known significant residual risks associated with non-ionizing radiation. Risks are reduced by design using components or solutions compliant with all the relevant technical standards.

You must consider non-ionizing radiation when integrating or interfacing with attachments or other equipment:

- Unintentional electromagnetic (EM) radiation: Most powered electronics components emit and are subject to the effects of electromagnetic radiation.
- Intentional radiation (radio frequencies): If wireless communications are used.
- Light sources, for example in attachments projecting visible lights.
- Laser sources, for example in attachments using measurement or pointing.

2.9.3.1. EM radiation considerations

Spot meets the requirements for unintentional radiators according to electromagnetic compatibility (EMC) standards related to heavy industrial environments (IEC 61000-6-4) and is able to withstand EM disturbances typically found in industrial environments (immunity) within standardized limits.

Test	Level (IEC 61000-6-2)
ESD	+/- 4 KV direct contact, +/- 8 KV air discharge
RF Immunity	10 V/m 80 - 1000 MHz, 3 V/m 1 - 6 GHz

WARNING

Using Spot in environments with exceptionally high EM disturbances, or integrating high-emission attachments, may result in unexpected behavior from Spot.

2.9.3.2. Radio Frequencies (RF)

Spot uses a WiFi radio module and meets the requirements for intentional radiators set in the relevant international technical standards.

You should estimate the probability of augmented influence of RF that could affect or compromise the conditions for immunity of Spot from:

- The integration and configuration of attachments that can intentionally emit powerful RF.
- The proximity to equipment capable of powerful RF emission.

Additionally, the availability of the networking infrastructure and its potential failures may also affect the probability of unexpected loss of communication or alteration of the nominal wireless protocols.

2.9.3.3. Laser

Spot contains five stereo camera systems that contain a Class 1 laser projection system.

This product is classified as a Class 1 Laser Product under the EN/IEC 60825-1, Edition 2 (2007) and Edition 3 (2014).

CAUTION

Do not tamper with or make adjustments to any of Spot's laser components. Doing so may result in hazardous radiation exposure. Use of controls or adjustments or performance of procedures other than those specified herein may also result in hazardous radiation exposure.

2.9.4. Noise

The airborne noise generated by Spot is determined by the environment Spot is operating in. For instance, Spot will generate much less noise walking across a padded carpet floor than it will walking up metal stairs.

Before putting Spot into regular use, work with your Environmental Health and Safety team to determine if additional Personal Protective Equipment (PPE) is required due to the noise Spot generates in its working environment.

2.9.5. Fire, explosion and hazardous materials

There are no known significant risks associated with Spot's lubricants.

The battery pack contains cells that have electrolytes. All cells are fully enclosed in a sealed enclosure that has passed UN 38.3 transportation testing. In addition, the pack has CB Certification to IEC 62133 and has passed drop testing with no leakage of electrolyte.

DANGER

In the unlikely event of damage with visible breakage of any part of Spot or its batteries, **DO NOT** touch or attempt any recovery.

It is extremely unlikely that the battery generates fire under normal conditions of use and environment. If the battery catches fire, do not try to put it out. Evacuate to a safe area and call the fire department. Battery fires create toxic fumes and cannot be put out with conventional fire extinguishers or water.

2.9.6. Unintended contact and other hazards related to locomotion

Spot is a legged robot: It maintains balance and moves using dynamic control principles. Spot uses sensors (not strictly necessary for locomotion) for improving the perception of the ground and the surrounding environment.

The conditions of the environment are the main, if not the only, reason for instability and the possibility of failures during locomotion.

WARNING

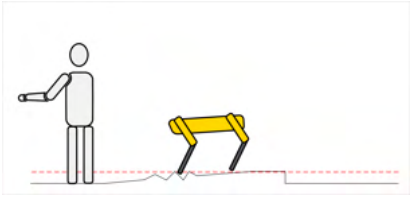
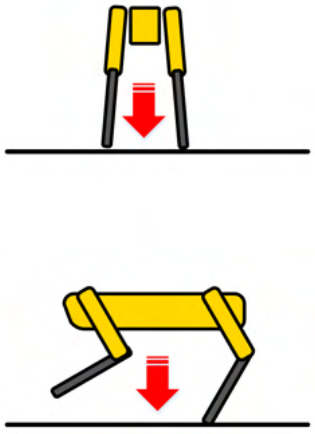
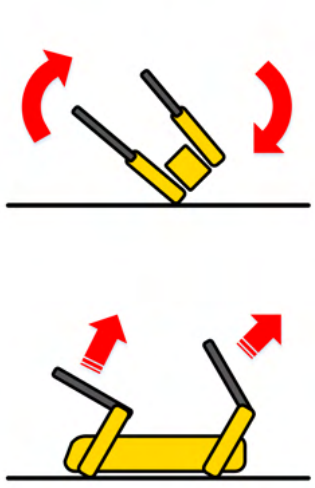
Hazards during Spot locomotion happen in the form of unintended behaviors:

- Unpredictable movements of the legs, following a temporary loss of stability and consequent recovery attempts.
- Large deviations from planned and expected paths.
- Sudden accelerations of either the legs or the entire robot as a reaction to external disturbances, like physical impact or the appearance of obstacles.
- Unpredictable movements following a tripping event.
- Sliding or tumbling following a fall or tip-over.
- Any combination of the above.

Consider the guidelines in the following paragraphs to estimate the severity and occurrence of the hazards listed above with respect to the conditions of your specific environment and application.

2.9.6.1. Accidental impacts during normal locomotion on flat, non-elevated grounds

Always consider the position of Spot with respect to an affected person to estimate the severity of hazardous conditions.

Situations		
 Elevation < 300 mm	 (a)	 (b)
Considerations for the severity of hazards		
When Spot is actively moving, accidental minor impacts may occur only with the lower body (feet and lower legs). While moving and balancing on legs, any accidental impact with Spot would be a short event (< 100 ms), followed by a recoiling movement that will not sustain any pressure on the human body. The severity of impacts is in general low.		
Even in case of a loss of stability, Spot would remain mostly in the same location. • A sudden, mostly vertical collapse of Spot or a forced stop (a) is almost invariably associated with low or negligible risk. • A tip-over on a predominantly flat surface rarely results in more than a half turn (b). In case of a tip-over, the legs are powered off. Legs can extend by the effect of inertia after motor power is disabled during the fall event. The severity associated to this situation is in general low due to the very limited energy of the residual motion (powerless legs).		

Situations
Alteration factors depending on application: • Lateral and rear directions of approach may affect human knees differently. • Indirect hazards caused by secondary effects (e.g. becoming entangled with and pulling on overhanging equipment). • Presence of very tall attachments.

Always determine the actual likelihood of the occurrence of each potential configuration based on your knowledge of the application, the environment, and the type of exposed persons.

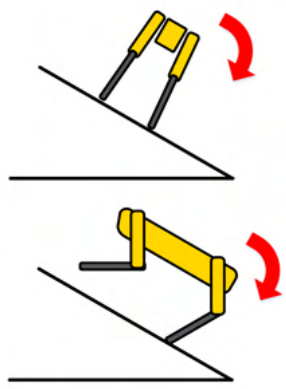
Considerations for the occurrence of hazards	
Factor	**Analysis**
Frequency and duration of exposure	Foreseeable hazardous exposures are limited in time, typically: • Less than 1 minute per interaction when Spot is operating in automatic mode. • Less than 10% of the total usage time when Spot is operating in areas with restricted access. • Several minutes, up to 1 hour, when Spot is being operated in manual mode (recording missions, remotely-controlled operations). Manual-mode events are longer than automatic-mode events, but happen much less frequently. Low frequency leads invariably to low occurrence when associated with regular skills and high awareness of affected people.
	Alteration factors depending on application: • Average presence of working personnel up to 25% of the total usage time. • Shared areas used by many people, increasing the total exposure.
Availability or probability of failure	Spot normally activates its collision avoidance capability. Accidental collisions may occur.

<table>
<tr><th colspan="2">Considerations for the occurrence of hazards</th></tr>
<tr><td></td><td>Alteration factors depending on applications:
Increased likelihood of failure to detect an obstacle when the environment limitations are not met (see 2.8.2: Navigational conditions).
Sudden appearance of obstacles around blind directions.
NOTICE
When the environmental limitations are not met, the performance of sensors may be downgraded in ways that are insufficient to generate complete failures but could determine a delay in the detection of obstacles.
NOTICE
Downgraded perception may determine irregular, possibly fast, movements in non-travel directions.</td></tr>
<tr><td rowspan="2">Behavior of affected people</td><td>Spot is in general distinctively visible.
Missions follow very regular and repeatable paths.
Spot’s size makes it possible to easily maintain clearances.</td></tr>
<tr><td>Direction of access
Share of spaces and lanes
Crosswalks
Non-task based interactions
Familiarity with other Autonomous Mobile Robots (AMRs)</td></tr>
<tr><td rowspan="2">Avoidability</td><td>Spot is in general distinctively visible.
Missions follow very regular and repeatable paths.
Spot’s size makes it possible to easily maintain clearances.</td></tr>
<tr><td>Spot may become less avoidable with:
Frequent and combined blind corners and/or cluttered environments.
Unsignalled concurrent presence on stairs when staircases are blind and narrow.
Unprotected open edges or elevated surfaces where the environment has not been prepared.</td></tr>
</table>

Considerations for the occurrence of hazards	
Skills of exposed people	• Spot is not intended to be used without an initial training. • In industrial applications, some level of understanding and anticipation of Spot's behavior is always assumed. • Authorized persons are always classified as high-skill, resulting in low occurrence of risks.
	• Skill level decreases with time elapsed from initial training or the lack of occasions to be exposed to encounters with Spot as a bystander. • Non-professional affected people are in shared areas. • Contractors or occasional bystanders are not trained or informed.
Quickness	• Spot normally walks at up to human speed, with a maximum speed of 1.6 m/s. • Sudden falls (not anticipated by some progressive instability) or unexpected lateral movements happen only under rare circumstances. • Accelerations and any change of pattern do not occur in a timeframe shorter than 1 second.
	• Very slippery ground. • Suddenly broken walking surface. • Almost invisible tripping hazards, like ropes or rebar too thin to be distinguished from the background.

2.9.6.2. Loss of stability and falls

Spot stands up and keeps balancing only with active control. However, active control does not ensure that stable balancing is always attained.

Situations		
	 *Elevation < 1100 mm*	 *Elevation > 1100 mm*
Considerations for the severity of hazards		

Situations
As a result of a loss of stability, Spot will de-energize its legs to avoid additional hazards during potential uncontrolled tip-over movements. If residual motion under gravity can occur (see also 2.9.6.3: Hazards associated with stopping or other powerless motion), the severity will depend on the starting conditions: • Elevation < 1100 mm: Low-severity minor impacts with the lower human body (feet and lower legs); • Elevation > 1100 mm: High severity if impacts can affect the full human body, which is possible only for full-drop (almost vertical) falls or tumbles that originate in the upper region of the elevation.
Alteration factors: • Type of terrain, which may amplify or attenuate the effects of the event. • Body size and age of the affected person.

Estimate the likelihood of occurrence of a loss of stability based on your knowledge of the following factors:

- Movable, tilting, or floating platforms or portions of walking surfaces in the area of operation that occur after the preparation of the environment.
- Areas of the environment such as the walking surface that are rendered weak, fragile, or unstable by changes in the operational layout (e.g. construction or excavation).
- Lubricants or other hazardous or slippery materials that occur in the operational environment and are not detected and resolved by site management.
- Undetected damage such as broken pipes, cords, or unstable materials in the operational environment.

2.9.6.3. Hazards associated with stopping or other powerless motion

Spot will automatically disable motor power in the following cases:

- As a result of a detected failure or a detected fall.
- As a result of a safety-related stopping function forcing a de-energized state.

Spot's legs will not be locked during and after a motor de-energization.

NOTICE

A random locked configuration of the legs would likely result in an unbalanced condition for the whole robot.

A random locked configuration of the legs during a tip-over or fall event would increase the likelihood of accidental impact with rigid objects (and increase severity).

During a stop event, Spot will attempt to lower its body in control before full de-energization. However, Spot may occasionally not finish reaching a safe state because the ground conditions (friction,

firmness, etc.) may force Spot to iterate its gait to secure its footing. Spot will eventually de-energize but could have passive residual motion (e.g. slide down an incline).

You should estimate the likelihood ofoccurrenceof passive residual motion considering the following factors:

- Residual motion without power happens solely under gravity and elevated grounds.
- Residual motion is very unlikely to happen if an elevated ground has no inclines in proximity to Spot.
- Flat or slippery surfaces increase the likelihood of residual motion because they do not offer natural obstacles to stop Spot. Rough and uneven terrain may reduce sliding effects. Stairs, however, offer few and small contact points, making sliding and/or tumbling more likely to occur.
- High inclination of surfaces (out of specifications) will increase the likelihood of tumbling instead of simple sliding.
- The presence of tall attachments significantly increases the likelihood of tumbling.
- Residual motion can last longer when there is a long distance from the point where the de-energization happens to the next sufficiently large landing point.

The configuration of Spot (body attitude, configuration of legs, forward/backward swing direction of each leg, inclination with respect to the main direction of a slope) during a sudden stop or fall event is entirely unpredictable.

2.9.7. Pinch points during motion

Pinch points are present around the joints and legs (see 3.2.1: Pinch points) and cannot be entirely eliminated without compromising the mobility of the legs, or the ability to walk and maintain balance.

Spot pinch points are situated in areas that are not normally reached in situations other than handling and transportation (while Spot is powered off). When motors are active, there is no foreseeable use that would require access to legs and joints.

When evaluating the hazards associated with pinch points, estimate the following factors:

Location	Severity	Occurrence
Hip pivot joint	The potential pinch point is located in the turning element of the hip, approximately 5 cm beneath the external surface elements of the hips and legs, with a single finger-size gap. Up to partial laceration or minor fracture, unlikely to reach amputation level. Severity is moderate.	Very unlikely to reach the joint in normal situations or other than misuse. Occurrence is low.

Location	Severity	Occurrence
Hip rolling joint	The potential pinching surface is wide (Spot's shoulder and large parts of the upper leg). There are no edges sharp or small enough to cause lacerations or cuts. Severity is low.	Possible but unlikely to reach the pinching state. The pinching would affect the hand or palm while grabbing the entire robot body to unduly interfere with balancing while Spot is powered (misuse). Overall occurrence is low.

WARNING

Do not try to recover Spot by grasping or holding it up during an apparent loss of stability.

2.10. General warnings

Consider the following instructions when you analyze and evaluate your Spot application (during and after a risk assessment):

- Attachments can alter the stability and the overall energy of an accidental loss of stability.
- While Spotis paused, the sudden appearance of an obstacle could cause Spot to move away from the obstacle to maintain a sufficient or predetermined separation distance. Spot could accelerate in a direction different from the main locomotion direction.
- When traversing stairs or uneven surfaces, Spot could accelerate in any direction or change body attitude in an attempt to maintain balance.
- Previous observations are not a guarantee of future performance. The behavior of Spot while in motion can be variable or unexpected with respect to planned trajectories or movements already observed in similar conditions or during previous executions of the same operations.
- When the environment presents narrow passages, corners, or cluttered layouts combined with ground obstacles, Spot could use high-speed movements to maintain or regain balance. Spot could accelerate in a direction different from the main locomotion direction.
- Check the availability of sufficient clearances or determine the need for signaling low-clearance locations.
- Survey the environment to determine any deviations from the nominal conditions described in 2.8: Restrictions on the environment that can increase the chances of failures. Prepare the operating environment and layouts to reduce those identified risks.
- Consider introducing or upgrading guards in locations potentially exposed to falls from elevated grounds to best fit Spot's navigation capabilities (e.g. use dense mesh guards, avoid transparent materials, avoid ropes or thin elements).
- Determine if protective devices are suitable for integration with Spot as safety input devices for triggering safety-related stopping functions.

3. Transport, handling, and storage

3.1. Transport

Spot is transported in two customized cases designed exclusively for Spot and its accessories.

3.1.1. Shipping case specifications

Category	Specification	Value
Spot robot shipping case	Length	927 mm
	Width	546 mm
	Height	464 mm
	Empty case weight	20.4 kg
	Combined weight (case and robot)	47.6 kg
Spot Power Supply & Battery shipping case	Length	559 mm
	Width	432 mm
	Height	267 mm
	Empty case weight	9.2 kg
	Combined weight (case, charger, and one battery)	18.1 kg
	Combined weight (case, charger, and two batteries)	22.7 kg

NOTICE

Do not discard the case after removing Spot and its accessories. The case is designed for transporting Spot and its accessories, and for returning them to Boston Dynamics for service when necessary.

3.2. Safe handling

Power off Spot before handling, moving, or lifting.

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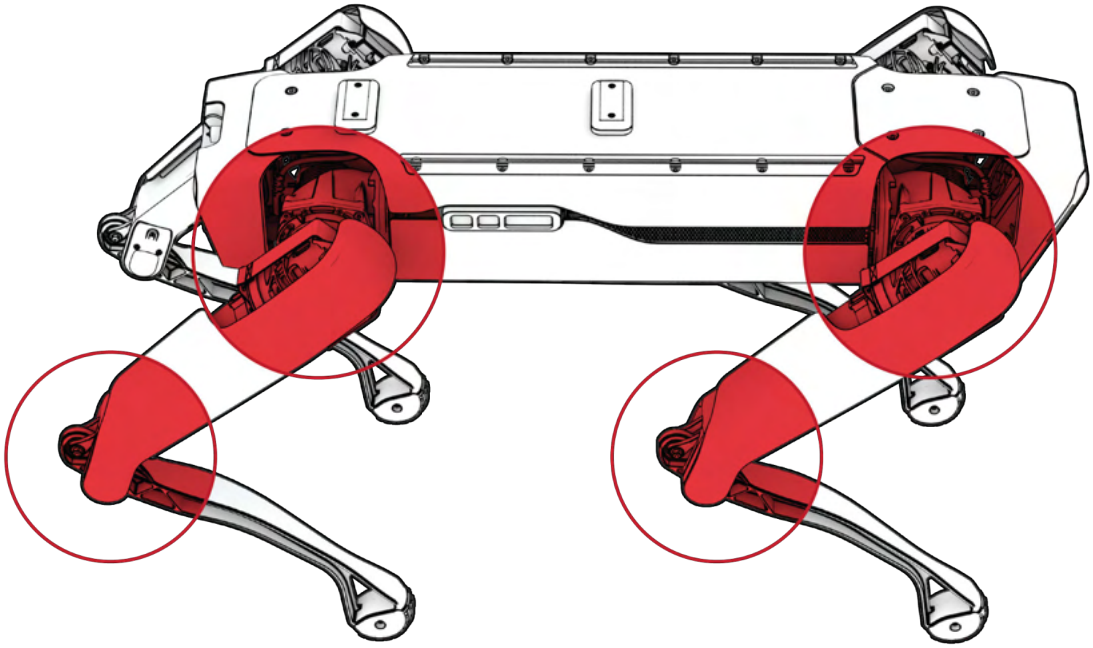
WARNING

Handling, moving, or lifting Spot without powering off Spot may result in unexpected motion and injury, as Spot may flail its legs in an attempt to control its balance.

For information about safely turning off Spot, see 5.11: Turning off Spot.

3.2.1. Pinch points

While Spot is powered off, loose legs and joints can still pinch fingers and other body parts and entangle clothing, long hair, and jewelry. Pinch point risk areas are highlighted below in red:



Spot pinch points.

CAUTION

Always keep hands away from knee joints. Use caution when rearranging or closing the legs.

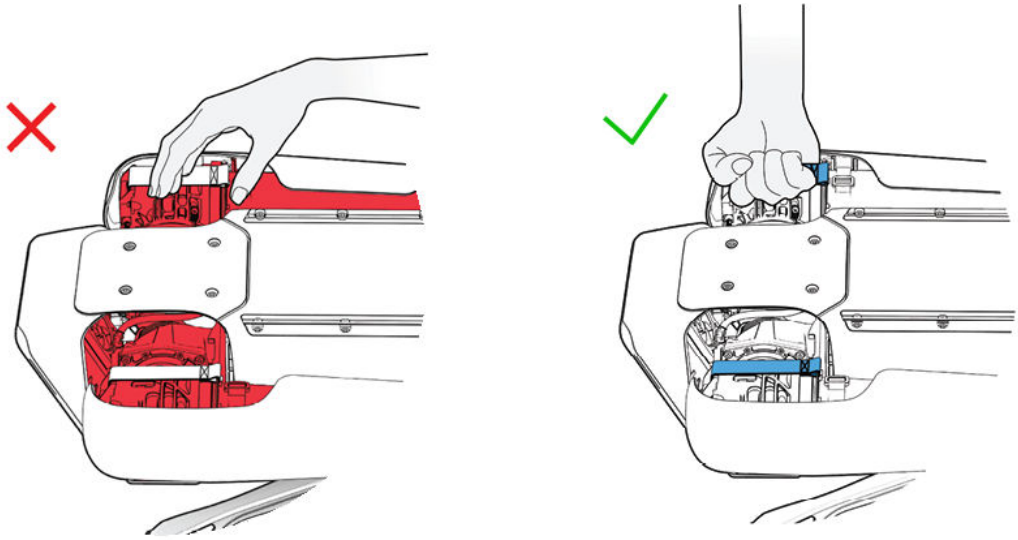
Always keep hands away from hip joints, except when grabbing the handles.

3.2.2. Handles

There is a handle at each hip joint to lift, carry, and roll Spot. Hands and fingers may still be pinched when using the handles.

WARNING

Always make a fist when gripping handles to keep your fingers away from pinch points. Never carry Spot with fingers extended.



Use of handles for lifting Spot.

3.2.3. Lifting Spot

Always use two people to lift Spot, one at the front and one at the rear.

Lift Spot by the handles while it is sitting upright, or by the lower legs if on its back. Always grab the handles or legs with clenched fists.

Lifting Spot by the handles.

Lifting Spot by the lower legs.

CAUTION

Spot is not a rigid single body, and its legs may be lose during lifting.

Sudden loss of grip while lifting will result in a sudden impact that may damage feet or equipment directly under Spot.

3.2.4. Personal Protective Equipment (PPE)

While handling Spot, it is recommended to wear safety footwear. Check for additional PPE that may be required in the application environment.

3.3. Storage

Spot is best stored in the case or at a Spot Dock when not in use. Store Spot in a dry location with temperatures between -40°C and 75°C, with relative humidity between 30% and 70%.

3.3.1. Battery storage

The Spot Battery should be stored at temperatures between -30°C and 25°C. It is recommended to develop a battery storage and charging safety policy consistent with industry standards and local regulations.

NOTICE

Always remove the battery when Spot is not in use unless Spot is connected to the Spot Power Supply or sitting on a powered Spot Dock. Batteries left in Spot while not in use will continue to discharge, even when Spot is powered off. Batteries left in a powered off robot for more than 24 hours may be damaged beyond repair.

CAUTION

When shipping the battery, make sure it has been discharged to a 30% or less State Of Charge (SOC). US and international transportation regulations require that lithium-ion batteries of this size be at no greater than a 30% SOC when shipped, regardless of the shipping method (air, ground, rail, or sea). To determine the SOC of the Spot battery, push the button on the battery and read the led indicators. When the indicator shows 1 bar, it means it has less than 30% SOC.

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4. Setup

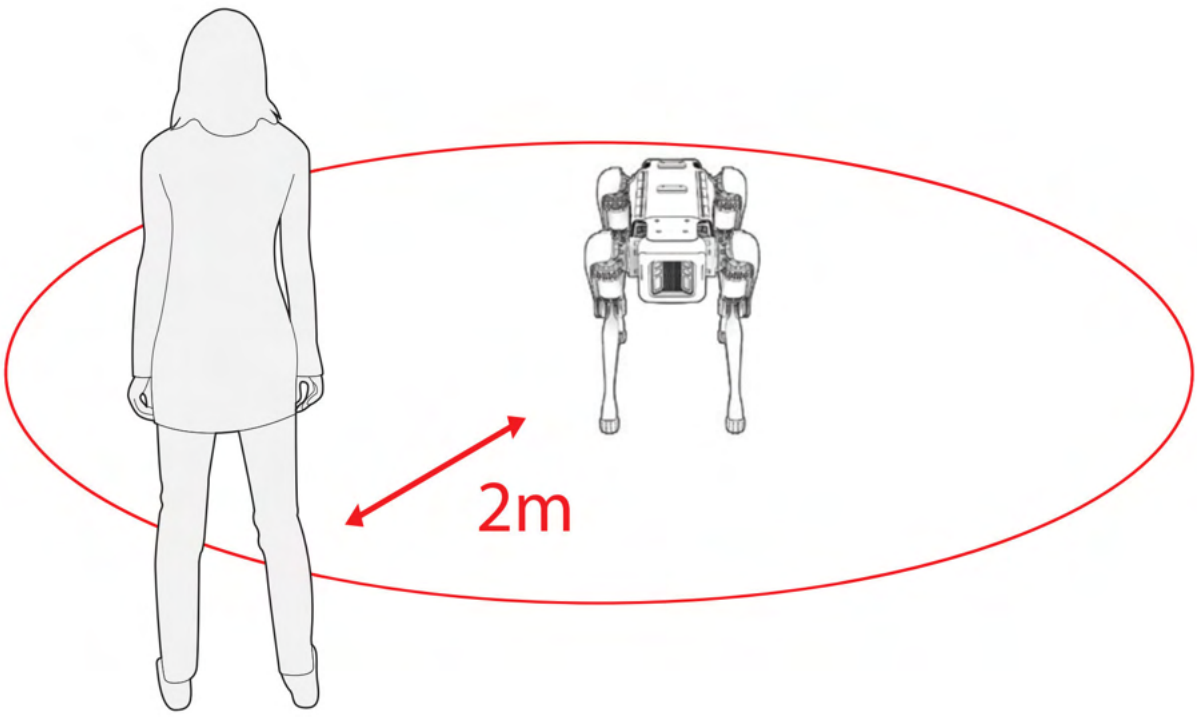
4.1. Before starting

Spot does not require any special installation fixtures, such as anchoring mechanisms, anti-vibration pads, etc. Setup can be done in any location.

Consider the following typical conditions for initial setup:

- Attachments may change the balance of Spot and must be configured for optimal control.
- Charging devices and cords may be present in the setup area. See also 4.3.2: Charging the battery.

In general, initial power-ups, standing, and movements of legged robots may be unfamiliar to first users. Ensure that all bystanders are trained in the use of Spot and about the residual risks of Spot applications.



2-meter safety zone around Spot.

CAUTION

Before setting up or operating Spot, ensure there is at least 2 meters of clearance around Spot in all directions.

Prepare Spot on a flat, stable, and clean surface.

4.2. Integrating attachments

Attachments are often essential components to integrate Spot into a final application. Attachments may substantially change the estimation of risks for Spot in the integrated solution, including:

- Introducing new hazards to Spot applications.
- Changing the risks associated with Spot's intended use.
- Changing the conditions for compliance with standards or local regulations.

4.2.1. Analysis of attachments

You must complete your own risk assessment (see the full procedure in 2.9: Risk assessment), considering the following elements that will affect the risk factors:

a. An attachment is outside the mounting limits established in 4.2.2: Attachment mount points and dimensions to ensure stability.
b. If an attachment can carry goods, the transported loads are:
    - Hazardous substances (chemicals, explosive and corrosive materials) either carried or dispersed (e.g. sprayed)
    - Non-hazardous materials that are not secured so that they cause a change in the physical properties of the load, are ejected, or accidentally come in contact with equipment or people.
    - Non-hazardous materials that, once loaded, exceed the stability limits in terms of rated mass or center of mass.
c. An attachment is actuated and capable of independent mobility, unless the movement is limited to one axis and/or does not exceed the geometry of the attachment (e.g. rotary cameras or scanners, pan/tilt cameras). Mobile attachments may in fact determine unforeseeable conditions for Spot:
    - Intentional or accidental contact with equipment or people.
    - Physical interaction or manipulation tasks that can have a direct or indirect effect on the touched objects.
    - Changes in stability conditions due to the disturbance introduced by physical contact with the environment.
d. An attachment emits light or collimated/amplified light like in lasers, unless classified as an IEC 60825-1 Class 1 device.
e. An attachment emits electro-magnetic (EM) radiation (unintentional emitter) and could have effects on the electromagnetic compatibility (EMC) of Spot.
    - If the attachment is not approved under local EMC regulations, Spot's conformity to EMC regulations does not extend to the attachment and the combination of Spot and the attachment is not in conformity to EMC regulations.
    - If the attachment is independently approved under local EMC regulations, you are still responsible for the EMC of the combination of Spot and the approved attachment, typically verified through testing.
f. An attachment has provisions for remotely triggering other equipment or processes, for example interfacing with components that start or stop processes or motion in target equipment.

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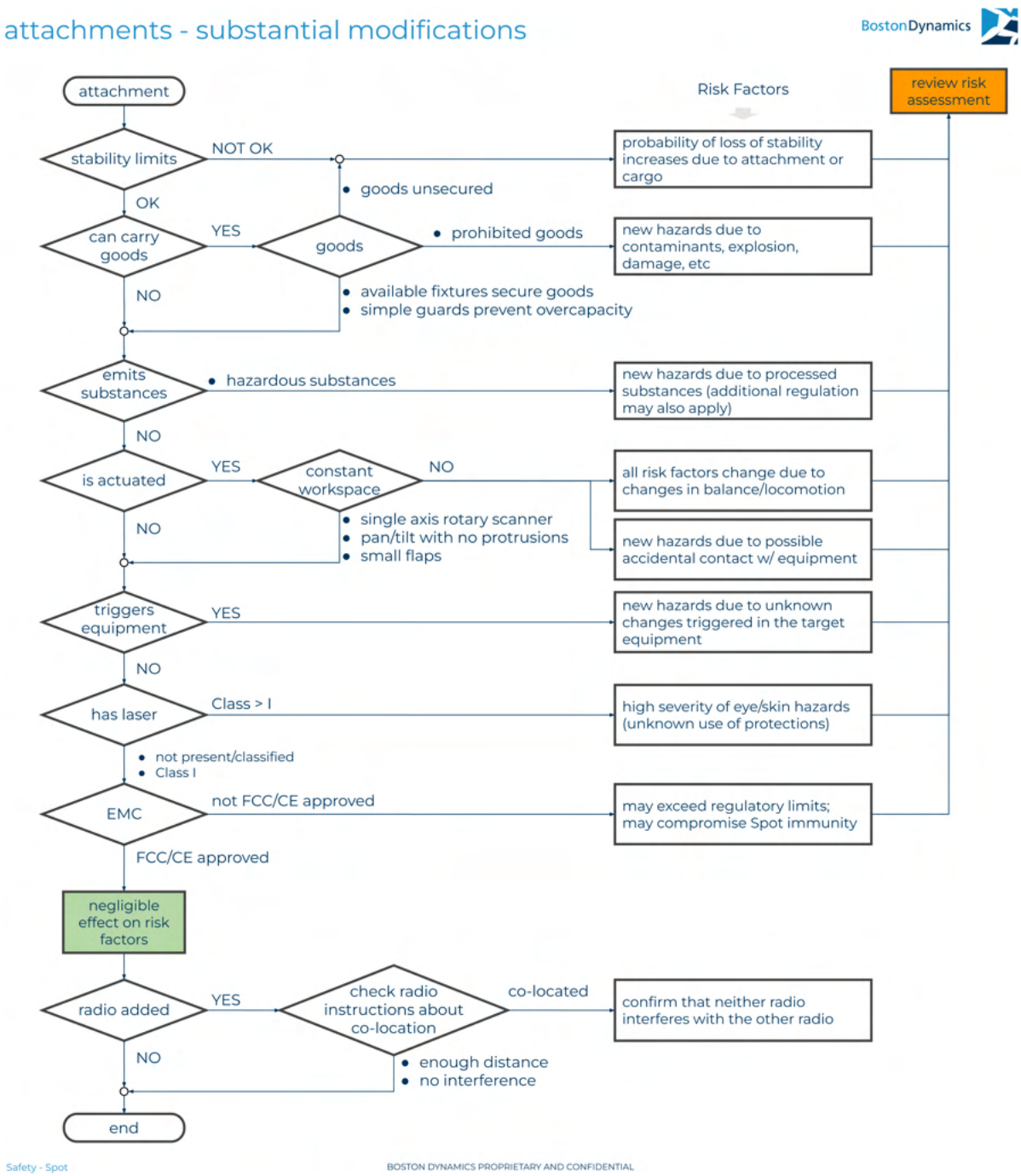


Flowchart of the process for analyzing attachments.

NOTICE

Radio equipment on attachments

Attachments may include radio devices. It is necessary to review installation conditions and approvals of radio modules.

- If the additional radio equipment is NOT an approved module for local radio regulation, the conformity to local radio regulation of Spot is invalidated and not extended to the attachment.
- If the additional radio equipment is an approved module for local radio regulation, multiple radio modules must still not be co-located (i.e. antennas are more than 20 cm apart). If co-located, testing must be performed according to the co-located radio device requirements for the local radio regulation.

Additionally, radiated emissions will need to be repeated with all radio modules enabled and activated to ensure that EMC has been maintained by the entire system (Spot and attachment). This applies to co-located and non co-located radio devices.

WARNING

Attachments that:

- emit ionizing radiation
- include laser equipment designated as IEC 60825-1 Class greater than 1
- carry or disperse hazardous substances

can be potentially very dangerous. Users and integrators will be responsible for providing additional safeguards.

WARNING

Spot has been tested to EMC Industrial standards. Attachments that emit radiation in excess of the levels Spot has been tested to may cause harm to Spot and degrade its performance in a dangerous manner.

Boston Dynamics is not responsible for any damage caused by radiating attachments.

You must also verify the presence of specific local regulations about the technology and materials used in attachments.

is an actuated, variable-configuration attachment, and every solution integrating requires a risk assessment for the intended manipulation application.

REQUIRED READING

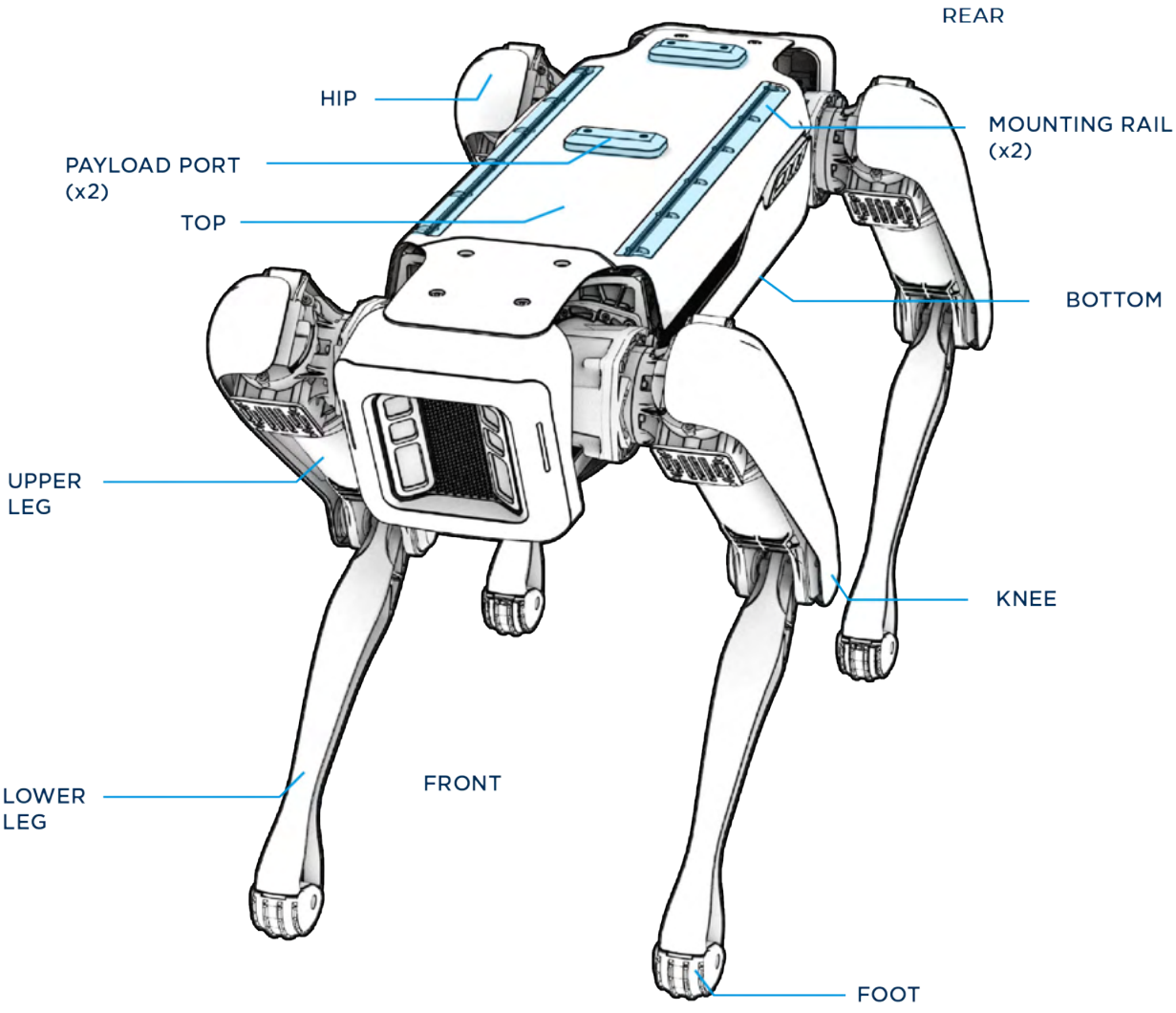
For additional instructions and safety information about , review *Spot Arm Information for Use* in the Boston Dynamics Support Center (see 8: Appendix A: Supplemental information).

All other attachments produced and sold by Boston Dynamics cause little or no modification in the risk estimation of Spot if used without further customization.

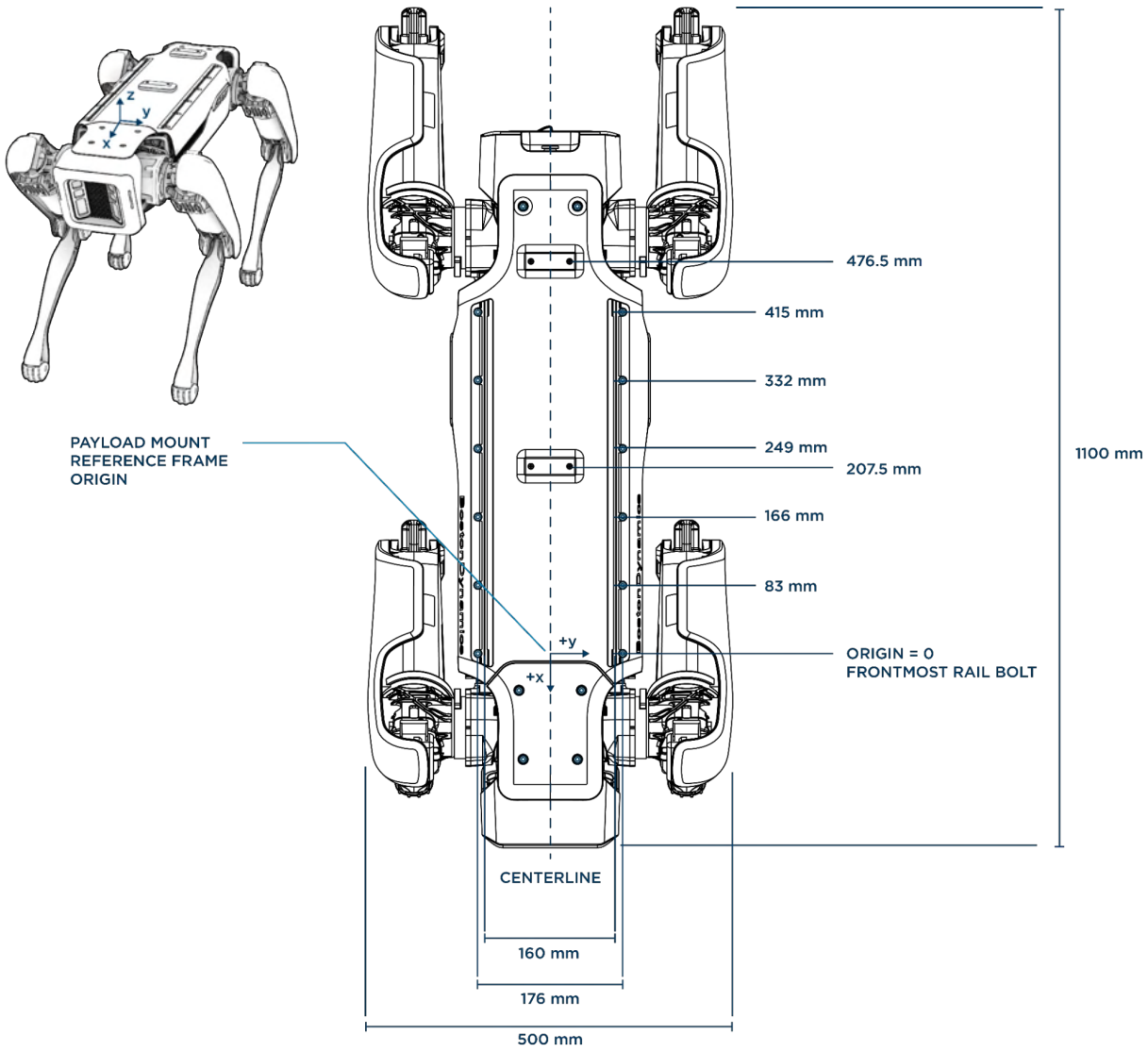
4.2.2. Attachment mount points and dimensions

Aluminum mounting rails are located along the top left and top right edges of Spot's body and provide a secure means of mounting attachments to Spot. The rails accept T-slot nuts such as Misumi HNTR5-5.

Power and data interfaces are available through Spot's forward and rear payload ports.

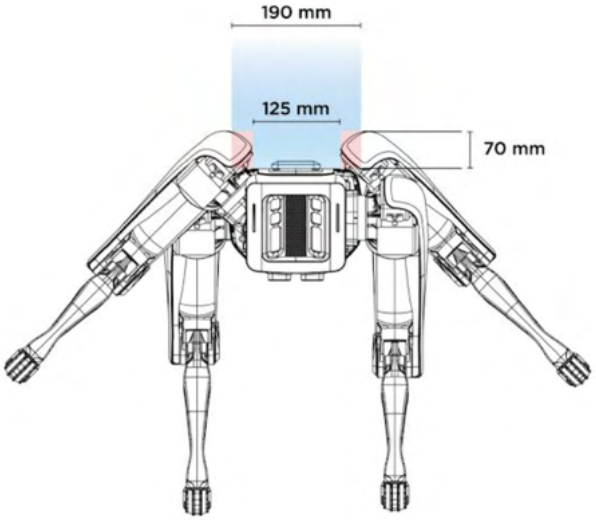


Spot mounting rails and payload ports (highlighted in light blue).



Spot dimensions with respect to mounting attachments.

The maximum recommended width for a body-mounted attachment is 190 mm. Attachments should avoid interference with the legs in the areas immediately adjacent to the hips, as illustrated below.

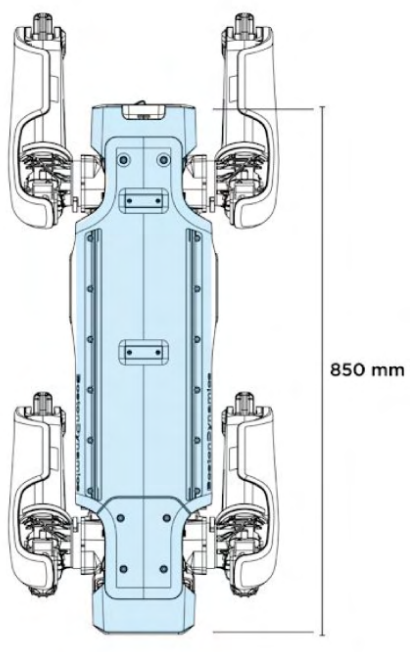


Attachment limit dimensions (lateral).

CAUTION

Attachments that exceed width limits will result in reduced overall mobility and significant interference with the legs, causing unintended loss of stability.

The maximum recommended length for a body-mounted attachment is 850 mm.

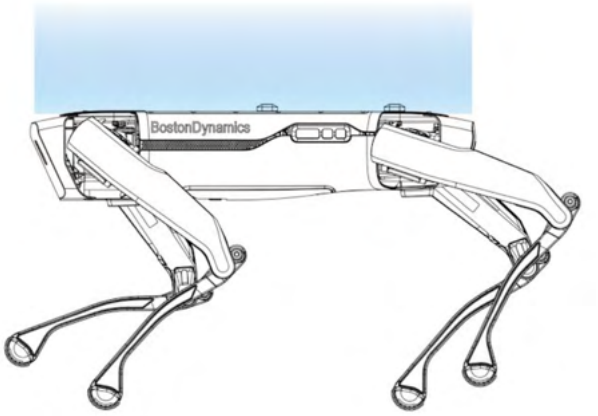


Attachment limit dimensions (longitudinal).

CAUTION

Attachments that overhang Spot's body to the front or rear will reduce maneuverability, increasing the probability of unintended movements to maintain stability or continue along a planned path.

The height of attachments impacts Spot's ability to self-right and increases the height of the center of mass. Keep the center of mass low, as Spot may not self-right if top heavy.



Vertical attachment zone (side view).

Spot can support 14 kg total combined capacity distributed over the top of its body. This total attachment capacity must include all attachments. Spot can better handle payload mass if the combined center of mass lies between the front and rear hips. Spot will be more agile and less likely to fall if the total attachment mass is centered on the middle of its body.

4.2.3. Mounting attachments

> **NOTICE**
> Attachments vary in size, shape, functionality, and configuration. The instructions in this section are a general guide. Refer to documentation specific to the attachment for instructions that add to or modify this procedure.

To mount an attachment to Spot:

1. Start with Spot powered off in the sit position on a stable work surface.
2. Position the attachment over Spot to identify where it will be bolted to the mounting rails and payload ports.

   > **NOTICE**
   > Some attachments can only be mounted in a front or rear configuration.

3. For each point where the attachment will be bolted to a mounting rail, insert one T-slot nut into the mounting rail. Position the T-slot nut along the rail, then gently tighten the set screw to hold the T-slot nut in place.
4. Insert the included machine screws through the holes in the attachment and into the T-slot nuts in the mounting rails, then tighten to 5 N·m of torque. Do not over-tighten.
5. If the attachment requires a power or data interface with Spot:
   a. Remove the screws holding the payload port cap in place, then remove the cap. Store the cap and screws in a secure location.

      > **NOTICE**
      > Spot cannot be operated with an exposed payload port.

   b. Insert the connector at the end of the attachment's ribbon cable into the payload port. Fasten the connector with the included screws.

Attachments must be configured in Spot's system software before use. For details, see 4.2.4: Configuring attachments.

WARNING

Mounting attachments incorrectly may cause failures in balancing and potential loss of stability, impaired functionality, and unforeseen hazards.

4.2.4. Configuring attachments

NOTICE

Attachments vary in size, shape, functionality, and configuration. The instructions in this section are a general guide. Refer to documentation specific to the attachment for instructions that add to or modify this procedure.

To configure an attachment for Spot:

1. Mount the attachment to Spot as described in 4.2.3: Mounting attachments.
2. Log in to Spot's Admin Console as described in 4.5.1: Log in to the Admin Console.
3. Select **Payloads**.
4. Some attachments will auto-register with Spot to streamline setup. If your attachment already appears on the page:
   a. Select **AUTHORIZE**.
   b. Select the configuration that matches your attachment (model and front or rear mount location), then select **AUTHORIZE**.
   c. To modify the default settings, select the attachment name. Configure settings for the attachment, then select **APPLY**.
5. If your attachment does not appear on the page:
   a. Select **ADD PAYLOAD**.
   b. Select an attachment type from the list.
   c. Configure settings for the attachment, then select **APPLY**.

WARNING

Incorrectly configuring attachments may cause failures in balancing and potential loss of stability, impaired functionality, and unforeseen hazards.

4.3. Battery setup and charging

Spot is powered by a removable lithium-ion battery pack.

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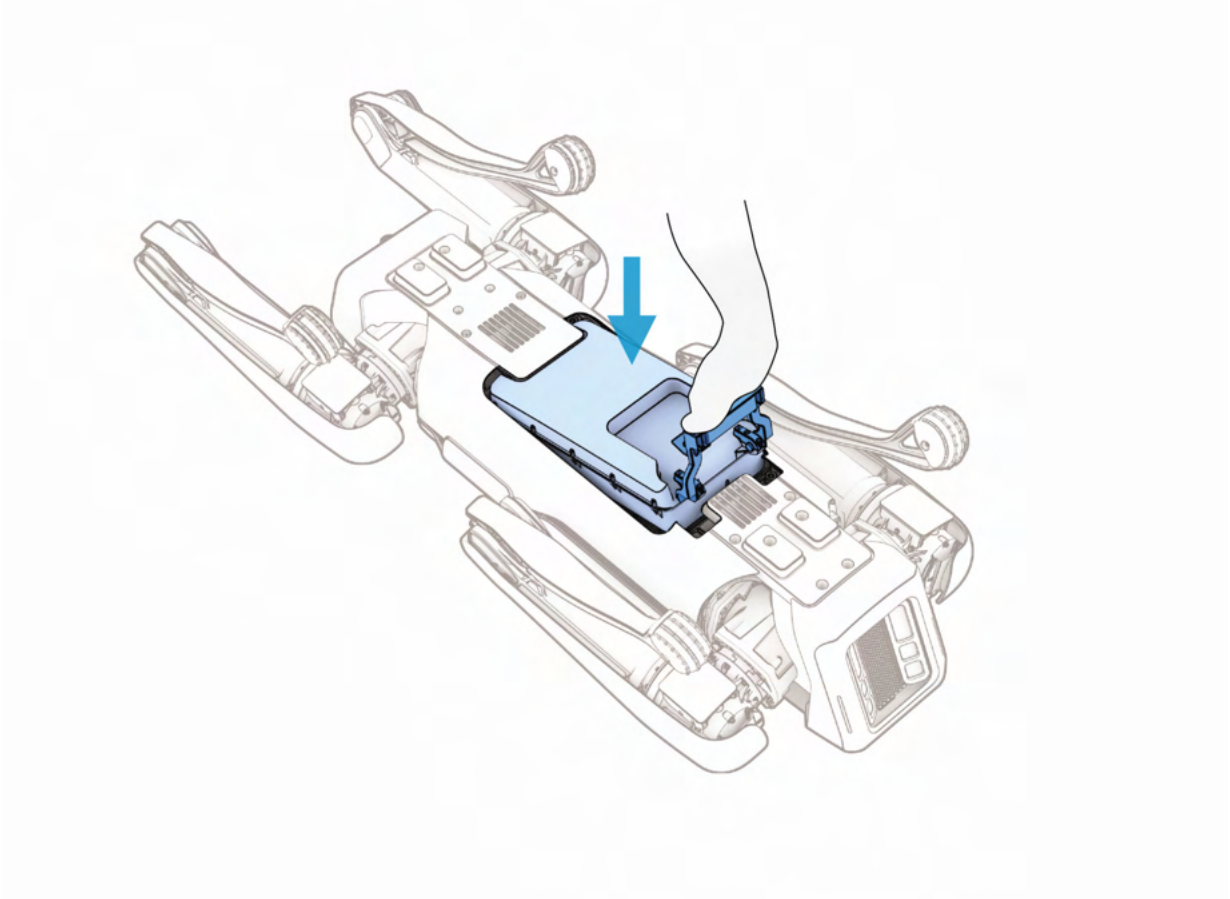
WARNING

- Do not short or contact battery pads.
- Do not burn, disassemble, submerge, puncture, crush, drop, or damage the battery.
- Do not dispose of the battery with household waste. Refer to local electric waste regulations.
- Do not charge, or operate Spot with, a battery that is cracked or otherwise damaged. For assistance with damaged batteries, contact Boston Dynamics Support.

DANGER

It is extremely unlikely that the battery generates fire under normal conditions of use and environment. If the battery catches fire, do not try to put it out. Evacuate to a safe area and call the fire department. Battery fires create toxic fumes and cannot be put out with conventional fire extinguishers or water.

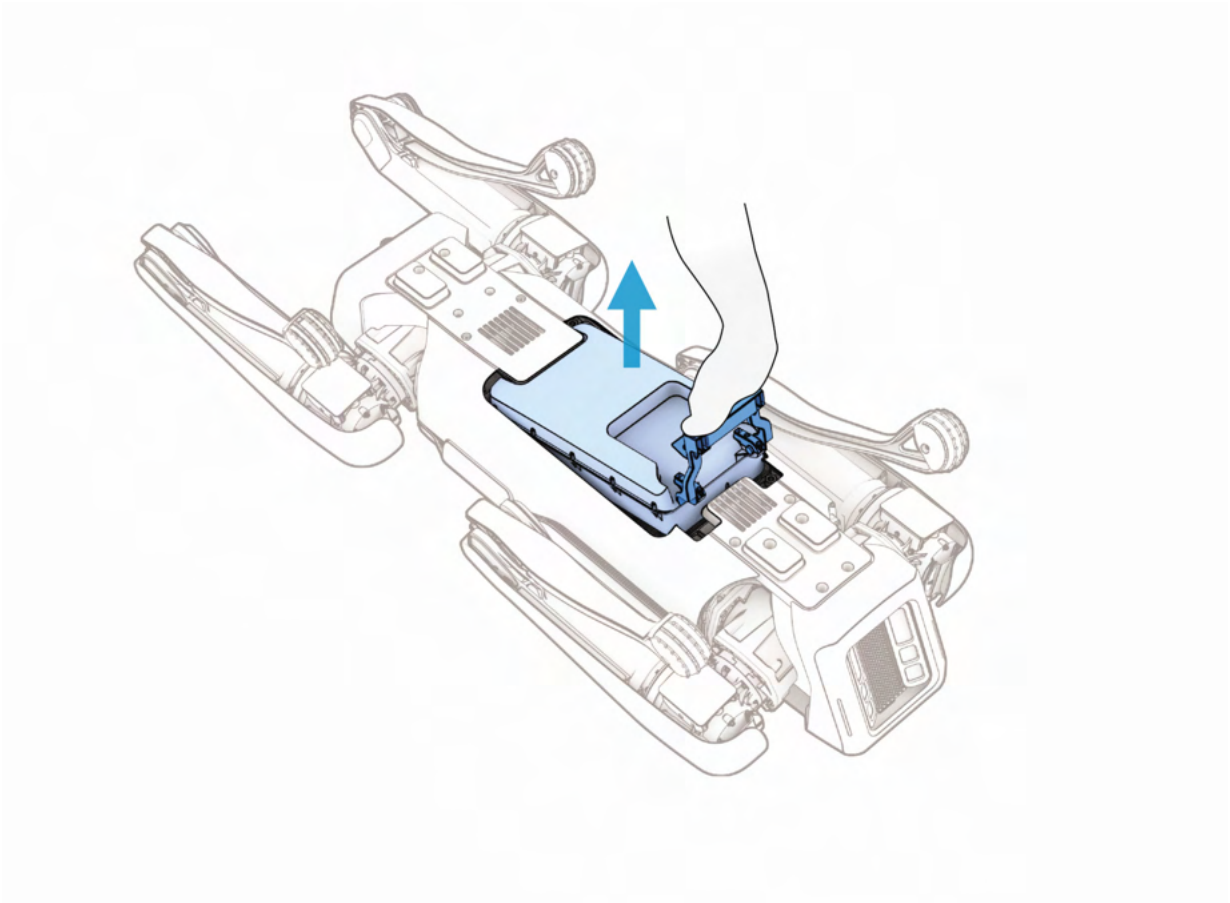
4.3.1. Inserting and removing the battery



Inserting the battery.

To insert the battery:

1. With Spot on its back and disconnected from power and Ethernet cables, slide the battery's non-handle side into the rear of Spot's battery compartment and latch the handle.
2. Ensure the battery is properly latched.



Removing the battery.

To remove the battery:

1. Ensure Spot is powered off and disconnected from power and Ethernet cables.
2. With Spoton its back, lift the battery handle and slide the battery out of the battery compartment.

4.3.2. Charging the battery

The battery can be charged in several ways:

- Removed from Spot, using the Spot Power Supply.
- While installed in Spot, using the Spot Power Supply.
- While installed in Spot, using the Spot Dock.

REQUIRED READING

Before charging a battery with the Spot Power Supply, review *Spot Power Supply Information for Use* in the Boston Dynamics Support Center.

Before charging a battery with the Spot Dock, review *Spot Dock Information for Use* in the Boston Dynamics Support Center.

See 8: Appendix A: Supplemental information

Only charge the battery with the Spot Dock or the Spot Power Supply provided by Boston Dynamics.

Charging a battery with the Spot Power Supply.

Charging a battery in Spot with the Spot Power Supply.

Charging a battery in Spot with the Spot Dock.

DANGER

To reduce the risk of electric shock and fire:

- Use a properly grounded outlet. Do not use ground adapters or replace plugs.
- Do not touch uninsulated parts of the output connector or battery terminals.
- Do not open or disassemble the Spot Power Supply or Spot Dock.
- Do not use the Spot Power Supply or Spot Dock if any power cord is damaged.

WARNING

Power cords present tripping hazards and may cause the Spot Power Supply to fall from an elevated position.

- Place the Spot Power Supply on a dry floor, out of the path of people or robots, while charging.
- Do not operate Spot while connected to the Spot Power Supply. Doing so could damage Spot or the Spot Power Supply. Dragging cords could become entangled with Spot, people, or objects in the environment.

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4.4. Spot Dock setup

The Spot Dock is a recharging station for Spot. The Spot Dock can also provide a pass-through connection for Spot's Ethernet port.

Before using the Spot Dock, check that the following conditions are met:

- The Spot Dock is securely installed on level ground.
- Clear space is available around the dock.
  - Front: 1200 mm
  - Sides: 50 mm
  - Rear: 600 mm
- The Spot Dock is undamaged.

REQUIRED READING

For installation instructions and safety information about the Spot Dock, review *Spot Dock Information for Use* in the Boston Dynamics Support Center (see 8 Appendix A: Supplemental information).

4.5. Spot system settings

Spot's system settings are managed from the Admin Console, which is a web server hosted locally on Spot.

Settings page	Description
User Management[1]	Create and manage operator and admin accounts. **NOTICE** Spot's default usernames and passwords are printed on a label in the battery compartment. Boston Dynamics strongly recommends changing the default passwords.
Network Setup	Configure Spot's WiFi and Ethernet settings.
Software Update [1]	• Review current software version information. • Upload and install new Spot software and monitor update progress.
Spot License	View and install license files required for Spot operation.

Settings page	Description
Logs	• Manage log files saved on Spot. • Upload logs directly to Boston Dynamics Support or download and send them from your own device. • Enable or disable image logging.
About	• Rename Spot. • Review software version. • Check cumulative runtime data. • Review legal information.
Payloads	• Add and configure new payloads. • Review payload settings.
General Settings	• Enable/disable privacy mode to prevent Spot from automatically capturing image data in log files. **NOTICE** Enabling privacy mode will not delete images stored in existing log files. • Configure fiducial image size and applicable ranges.
Battery	• View battery health metrics. • Clear battery logs.
	Access a history of WiFi network connections to Spot.
	Visualize the position and orientation of Spot's limbs and attached payloads.

[1]Admin users only.

4.5.1. Log in to the Admin Console

To log in to the Admin Console from the tablet controller:

1. Start with Spot powered on as described in 5.3.1: Power on Spot's computers.
2. Connect the tablet controller as described in 5.2.2: Connecting the tablet controller to Spot.
3. Navigate to **Menu ≡** > **ADMIN CONSOLE**.
4. Log in with the admin username and password printed on the label in Spot's battery compartment, or using credentials provided by your Spot system administrator.

To log in to the Admin Console from a computer:

1. Start with Spot powered on as described in 5.3.1: Power on Spot's computers.
2. Connect a computer to Spot using the information in 4.6.1: Default network configuration, or the current network settings as determined by your Spot system administrator.
3. Open the Chrome browser and navigate to Spot's IP address. For the default network configuration, the address is `https://192.168.80.3` when connected by WiFi and `https://10.0.0.3` when connected by Ethernet.
4. Log in with the admin username and password printed on the label in Spot's battery compartment, or using credentials provided by your Spot system administrator.

4.6. Network configuration

Spot requires an active network connection for remote controlled operation and remote supervision of automatic operation (see 5.8.4: Autowalk replay supervision). Communication requirements will vary based on where and how Spot is used.

Loss of communications may trigger an operational stop as described in 2.5.1: Operational stop.

Network type	Description
WiFi	Spot can host its own WiFi access point, allowing controllers and other devices to connect directly to Spot. Spot can also join enterprise WiFi networks.
Ethernet	There is one Ethernet port at the rear of Spot. Spot can also receive "pass-through" Ethernet while docked on a Spot Dock.
LTE	Requires additional hardware.
Mesh radios	Requires additional hardware.

Before operating Spot, ensure that Spot's network configuration is appropriate for your use case and operating environment.

4.6.1. Default network configuration

Default networking information is printed on the label inside Spot's battery compartment.

Network protocol	Setting	Default value
WiFi	Network type	Access Point (Spot hosts its own WiFi network)
	Network name (SSID)	See label in battery compartment
	Password	

Network protocol	Setting	Default value
	Robot IP address	`192.168.80.3`
Ethernet (Direct wired connection between computer and Spot)	Robot IP address	`10.0.0.3`
	Netmask	`255.255.255.0`

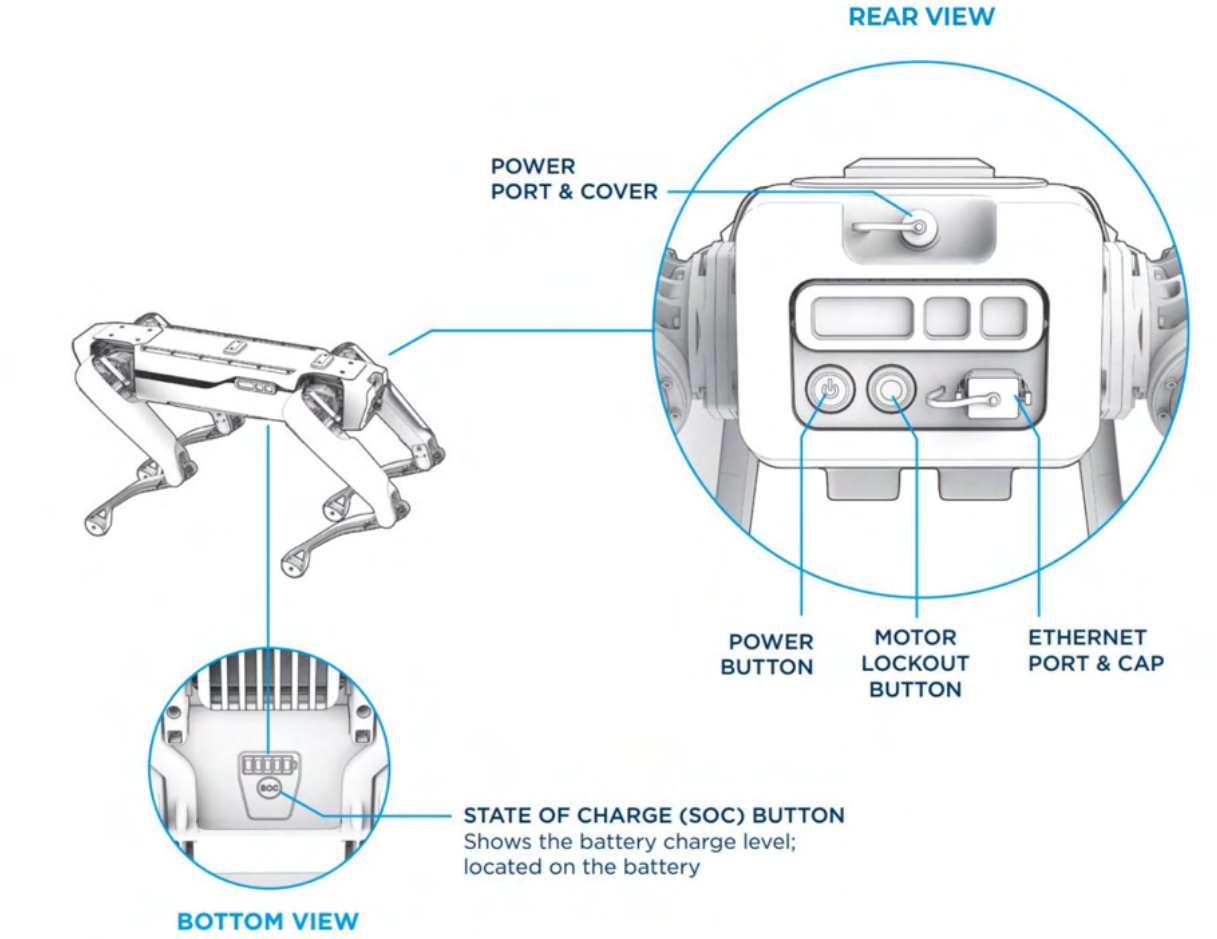
4.6.2. Changing the network configuration

To change Spot's network configuration:

1. Log in to Spot's Admin Console as described in 4.5.1: Log in to the Admin Console.
2. Select **Network Setup**.
3. Navigate between the tabs to access settings.
4. For each tab, make changes and then select **APPLY**.

5. Use of the machine

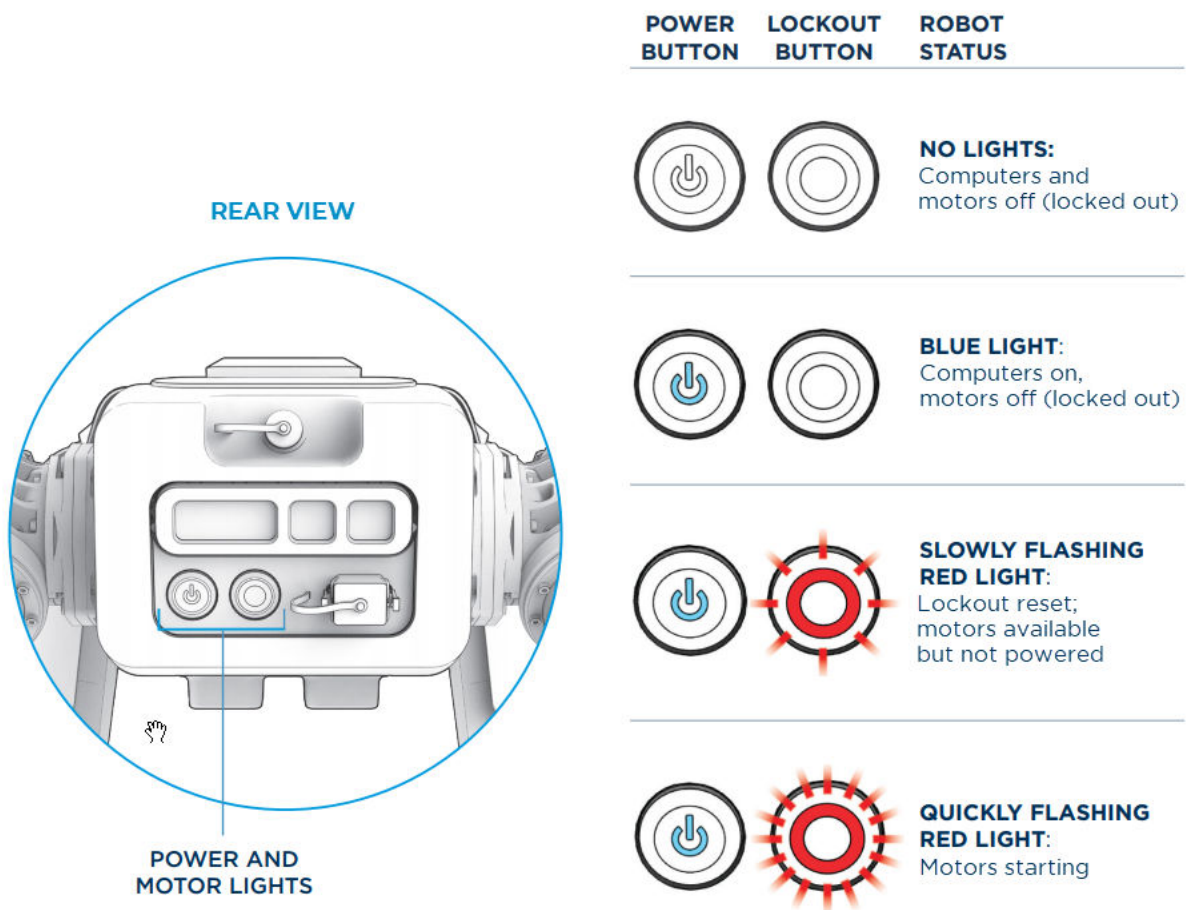
5.1. Controls and interfaces on Spot



Battery and power controls.

5.1.1. Power and motor status lights

The power and motor lockout buttons are located at the rear of Spot's body. The power button illuminates blue when Spot's computers are on. The motor lockout button illuminates red when the motor lockout is reset.

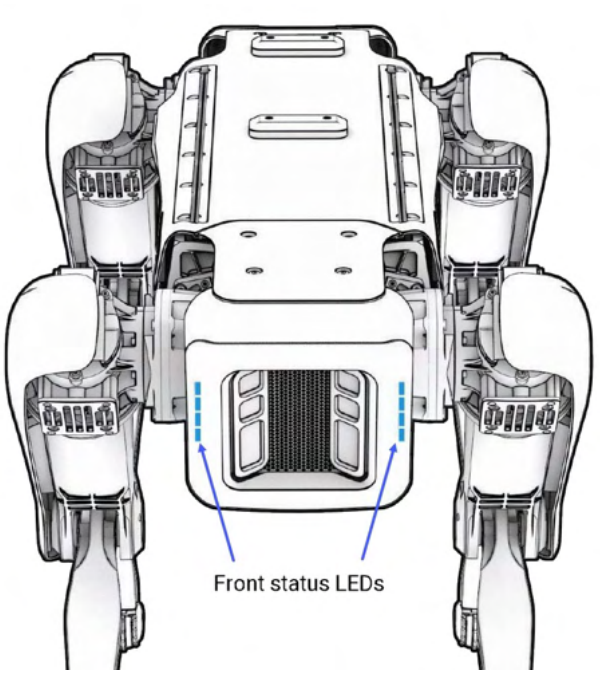


Power and motor status lights.

When Spot is powered on and motors are locked out (blue light only), motion commands are disabled. Spot will not move until the motor lockout is reset and Spot receives a start command as described in 5.3: Starting Spot.

5.1.2. Robot status lights

Spot's LED status lights are located on the front of its body.



Status light location.

Light pattern	Description	Robot status
	Yellow	System booting up
	Moving rainbow	Powered on, ready to connect
	Solid blue	Lockout button engaged; Spot is safe to handle
	Filling blue	Charging, dots indicate percentage of charge
	Solid blue with gap	Plugged in or docked, no battery
	Slow blink green	Spot connected; motors may turn on
	Fast blink green	Motors turning on
	Solid green	Motors on
	Draining orange	Low battery

Light pattern	Description	Robot status
	Blinking orange	Serious error or perception fault; operation degraded

5.2. Remote controllers

Spot can be operated with the tablet controller that ships with Spot, or from a computer running the Scout browser application. This document describes the use of the tablet controller. For instructions on using Scout, refer to documentation in the Boston Dynamics Support Center (see 8: Appendix A: Supplemental information).

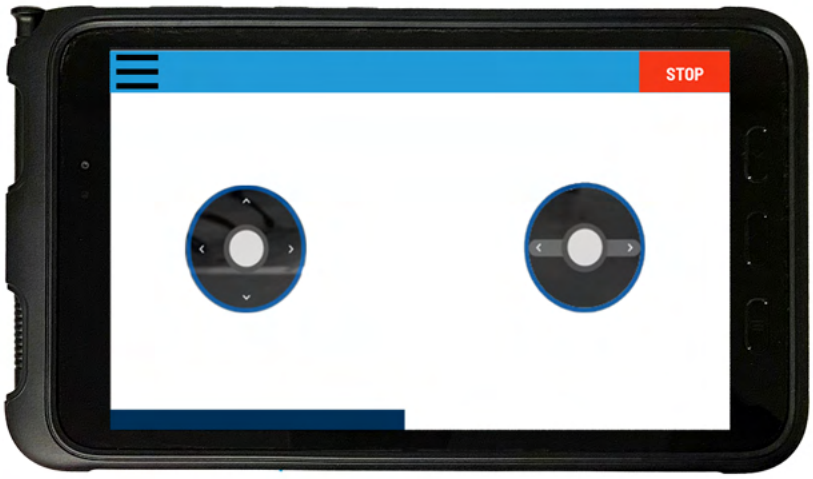
Control can be passed from one controller to another while Spot is in use. See 5.2.2: Connecting the tablet controller to Spot.

Spot may be compatible with other control devices and software. Only use controllers provided or approved by Boston Dynamics to operate Spot.

5.2.1. Spot tablet controller

The Spot tablet controller is a wireless device for manually operating Spot robots. Spot can be operated without the tablet controller, but the tablet controller is required for recording missions.

The controller that ships with Spot is a handheld touchscreen computer running the Android operating system and the Spot App. The controller can be integrated with hardware devices that include buttons and joysticks.



Spot tablet controller.

5.2.2. Connecting the tablet controller to Spot

To connect the tablet controller to a Spot robot for the first time:

1. Start with Spot and the tablet controller powered on. See 5.3.1: Power on Spot's computers.
2. On the tablet controller, open the Spot App.
3. Select **+ ADD NEW ROBOT**.
4. Select the network that matches the information in 4.6.1: Default network configuration, or that matches Spot's current network settings as determined by your Spot system administrator.
    a. If you are taken to the Android network settings screen, select the correct network and enter the password if required.
    b. If you see a message about the network having no Internet access, select **Always connect**.
    c. Press the tablet controller's back button to return to the Spot App.
5. If Spot appears in the **NEW ROBOTS** list, select it. Otherwise, select **+ ADD ROBOT** and enter Spot's IP address. (For the default network configuration, the address is `192.168.80.3`)
6. Log in with the admin username and password printed on the label in Spot's battery compartment, or using credentials provided by your Spot system administrator.
7. When prompted, press the **Cut Motor Power** button combination.
8. Select a start command as described in 5.3.3: Start Spot's motors, or select **OBSERVE** to access cameras, menus, and settings without starting Spot's motors.

To reconnect the tablet controller to a known Spot robot:

1. Start with Spot and the tablet controller powered on. See 5.3.1: Power on Spot's computers.
2. On the tablet controller, open the Spot App.
3. Select a robot from the **MY ROBOTS** list.
4. Log in with the admin username and password printed on the label in Spot's battery compartment, or using credentials provided by your Spot system administrator.
5. When prompted, press the **Cut Motor Power** button combination.
6. Select a start command as described in 5.3.3: Start Spot's motors, or select **OBSERVE** to access cameras, menus, and settings without starting Spot's motors.

To take control of Spot from another controller:

If you see a different button such as **OPERATE** or **HIJACK** when connecting to Spot, it may mean that Spot has already been started and is operating in automatic mode or under the control of another Operator. To finish connecting to Spot:

1. Select **OPERATE** (if applicable), then select **HIJACK**.
2. When prompted with the question "Do you want to acquire cut motor power authority?", select **YES**. Spot will sit and turn off its motors.
3. When prompted, open the Motor status panel and toggle **Motor Power** to **ON**.

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WARNING

Without cut motor power authority it may not be possible to stop Spot quickly. If another controller cuts power while you are operating Spot it may result in unexpected hazards. Do not operate Spot from a controller that does not have cut motor power authority.

CAUTION

Taking control of Spot during operation does not require the permission of other Operators and may cause unexpected hazards. Always carefully assess the situation and communicate with other operators before taking control of Spot.

5.2.3. Enabling AutoReturn to recover from loss of connection to the controller

Spot maintains a connection to a remote controller while operating manually. If the signal is lost, Spot will sit and power off its motors as described in 2.5.1: Operational stop.

Possible reasons for loss of signal include:

- Poor network performance.
- Weak or intermittent signal strength.
- The tablet controller powering off, entering a sleep or standby mode (such as turning off the screen), or changing its network settings.
- The Spot App crashing, being backgrounded, or being closed.

When enabled, AutoReturn allows Spot to backtrack automatically to a location within a set radius as it attempts to restore its connection to the controller. If the signal is restored, manual operation resumes. If the signal is not restored, Spot will sit and power off its motors.

To enable AutoReturn:

1. Navigate to **Menu ≡** > **COMMS**.
2. Toggle the **Enable AutoReturn** checkbox.
3. Drag the **Return radius** slider to change how far Spotcan backtrack when AutoReturn is triggered.

WARNING

AutoReturn can result in automatic movement. When the tablet controller is not connected to Spot, it may not be possible to stop Spot quickly. Use this setting only after carefully assessing the operating environment and the risks of unsupervised operation.

5.3. Starting Spot

Before starting Spot, make sure that it:

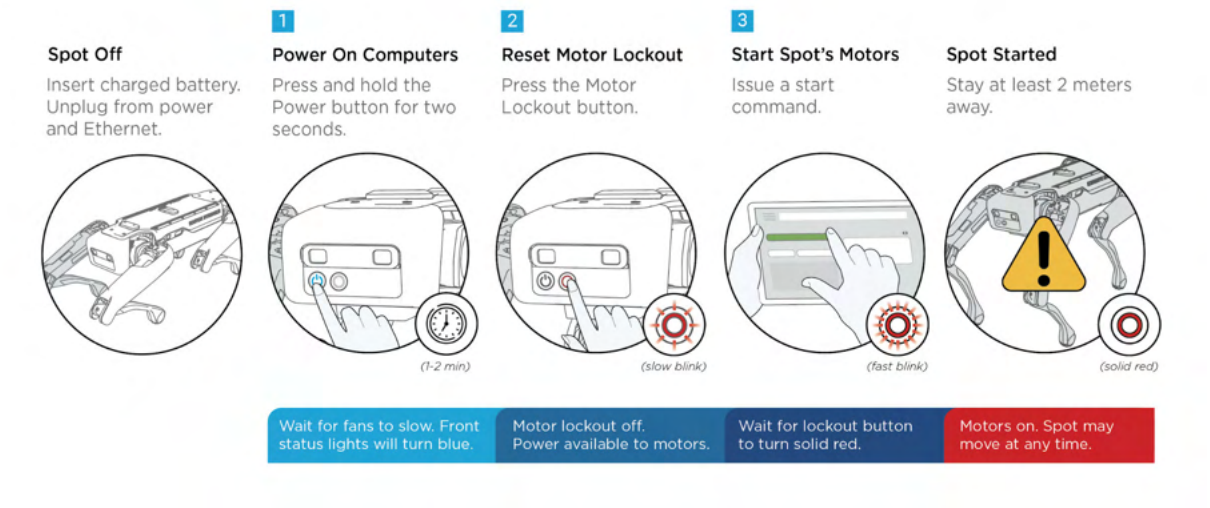
- Has a charged battery.
- Is unplugged from power and Ethernet.
- Has its power plug cover and Ethernet port cover inserted.

CAUTION

Before setting up or operating Spot, ensure there is at least 2 meters of clearance around Spot in all directions.

Starting Spot involves three steps:

1. Power on Spot. This boots up Spot's computers, but does not deliver power to Spot's motors.
2. Reset the motor lockout. The motor lockout prevents motor power. Once reset, power is available to motors but no motion command is enabled or allowed yet.
3. Start Spot's motors. This step is done on a remote controller. Motors are energized and Spot may move at any time.


Spot Off
Insert charged battery. Unplug from power and Ethernet.
1
Power On Computers
Press and hold the Power button for two seconds.
(1-2 min)
2
Reset Motor Lockout
Press the Motor Lockout button.
(slow blink)
3
Start Spot's Motors
Issue a start command.
(fast blink)
Spot Started
Stay at least 2 meters away.
(solid red)
Wait for fans to slow. Front status lights will turn blue.
Motor lockout off. Power available to motors.
Wait for lockout button to turn solid red.
Motors on. Spot may move at any time.

Spot startup sequence.

NOTICE

There may be additional power-up procedures for attachments installed on Spot and which use one of the two payload ports on Spot's top.

5.3.1. Power on Spot's computers

To power on Spot's computers:

1. Press and hold the Power button for two seconds.
2. The fans will turn on and spin for approximately two minutes. During this time, Spot's computers are booting and its hosted WiFi network is initiating.

3. When the noise of the fans is audibly lower and the status lights at the front of Spot change to solid blue, Spot's computers are powered on.

5.3.2. Reset the motor lockout

To reset the motor lockout:

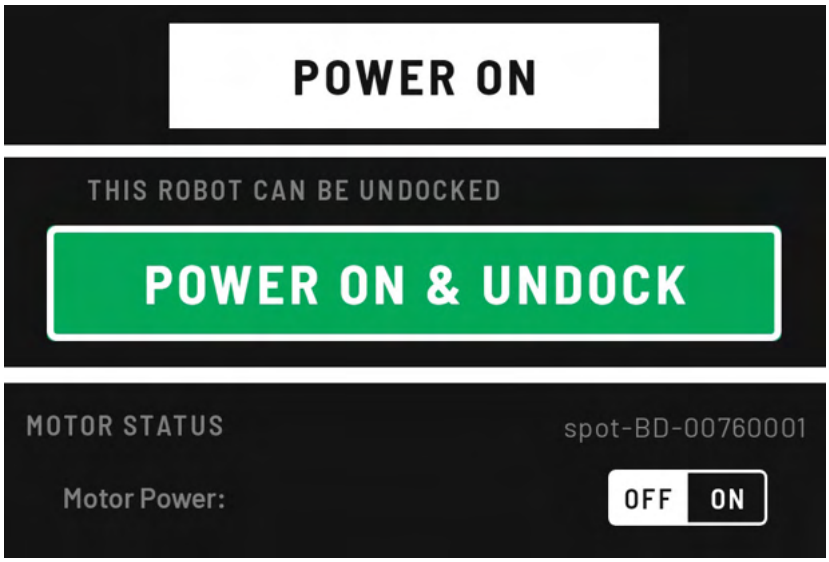
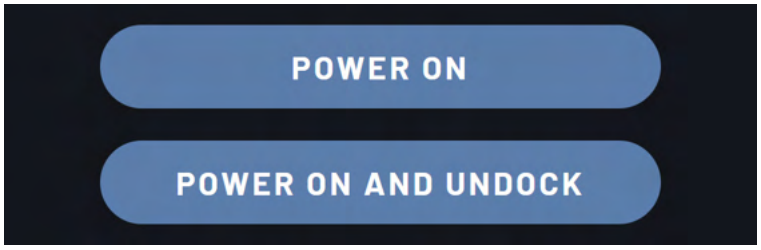
1. Press the Motor Lockout button on the rear of Spot.
2. If Spot's computers are already powered on, the button will illuminate red and slowly blink to indicate that the lockout is reset.

Spot will not start yet. A deliberate start command is necessary from an externally connected control device.

> **CAUTION**
> If a software command to start Spot is pending when the motor lockout is reset, Spot may immediately start its motors and begin moving.

5.3.3. Start Spot's motors

Start commands vary depending on mode of operation, controller type, and robot state. Examples:

Mode	Controller	Start commands
Manual	Tablet	
	Scout	

Mode	Controller	Start commands
Automatic	Spot's motors may start automatically, remain started, or re-start automatically to replay scheduled or looping Autowalk missions.	

The motor lockout button will blink quickly for several seconds while motors are starting. When motors are fully started, the button will glow steady red.

CAUTION

Once started, Spot may move suddenly and unexpectedly.

5.4. Stopping Spot

During normal operations, two stop commands are available:

- **STOP**: Immediately suspends all robot motion.
- **CUT POWER**: Fully de-energizes Spot's motors.

When **STOP** or **CUT POWER** is commanded, it takes precedence over all active commands on the controller. When **CUT POWER** is commanded, motors cannot be turned on until the stop is canceled.

An operational stop can be triggered:

- Manually by an operator.
- Automatically by Spot's internal control system.
- By additional software or attachments.

NOTICE

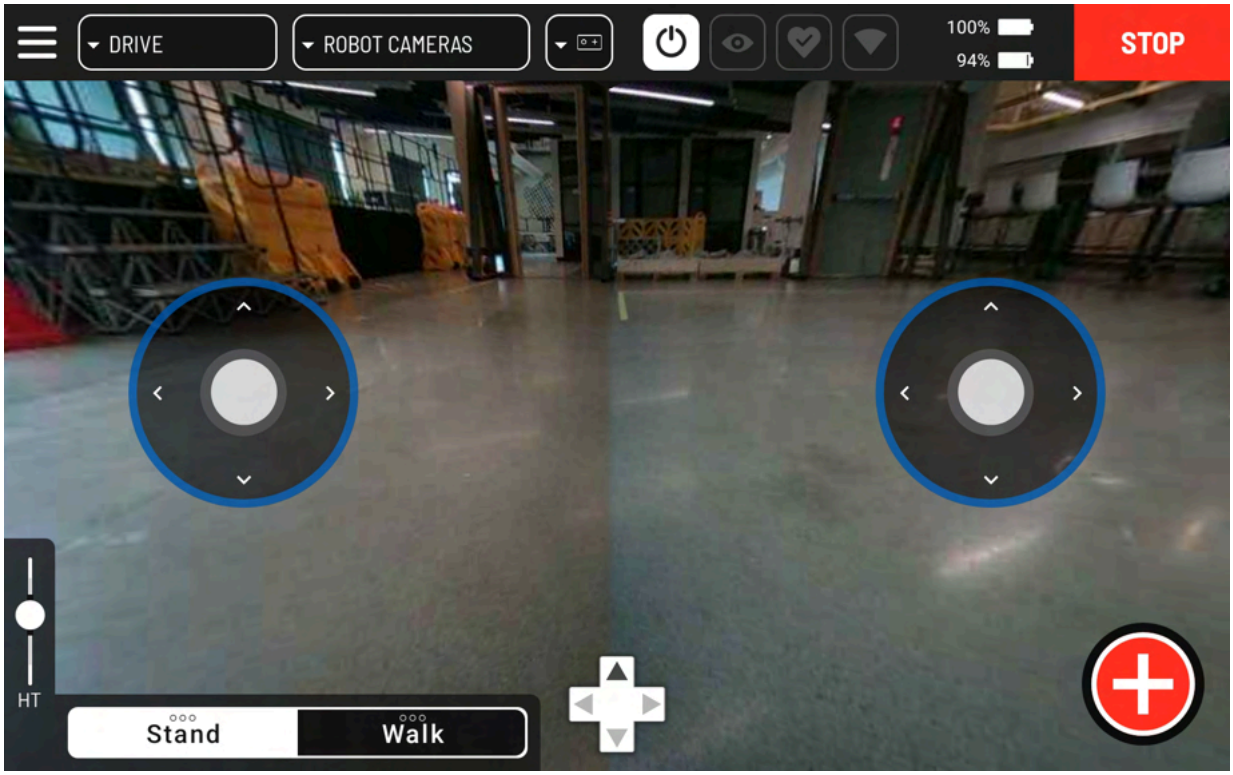
Many Spot behaviors can also be paused or canceled with on-screen controls or physical button shortcuts, however this document only describes the general stop function.

5.4.1. Manual stop using the tablet controller

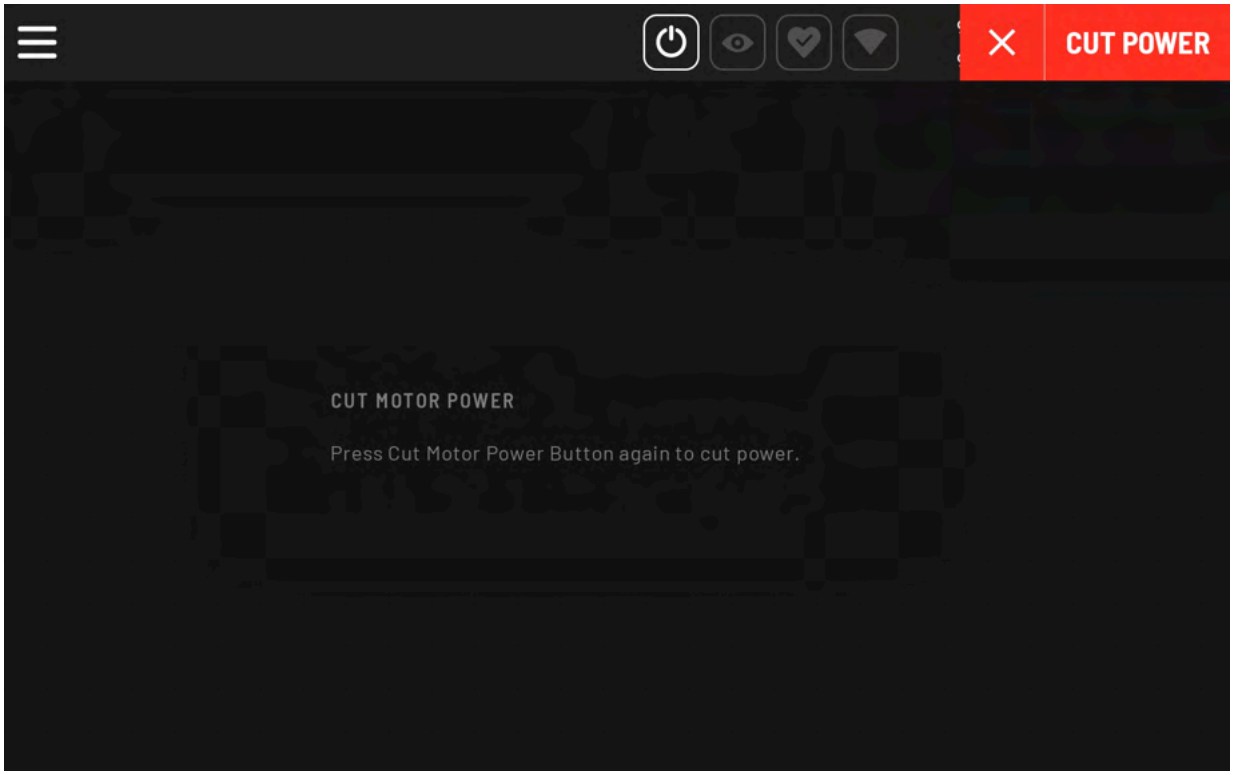
To suspend robot motion while driving Spot with the tablet controller, select **STOP**. Spot will pause and stand in place. If Spot is seated, it will remain seated.

To de-energize Spot's motors, use either of these methods:

- Press a shortcut combination of physical buttons to **Cut Motor Power**. This shortcut differs depending on tablet configuration and is displayed in the Spot App when an Operator connects to Spot.
- Select **STOP** twice in quick succession. The first selection will suspend robot motion and change the button label to **CUT POWER**. The second selection will de-energize the motors.



*Tablet controller **STOP** button.*



*Tablet controller **CUT POWER** button.*

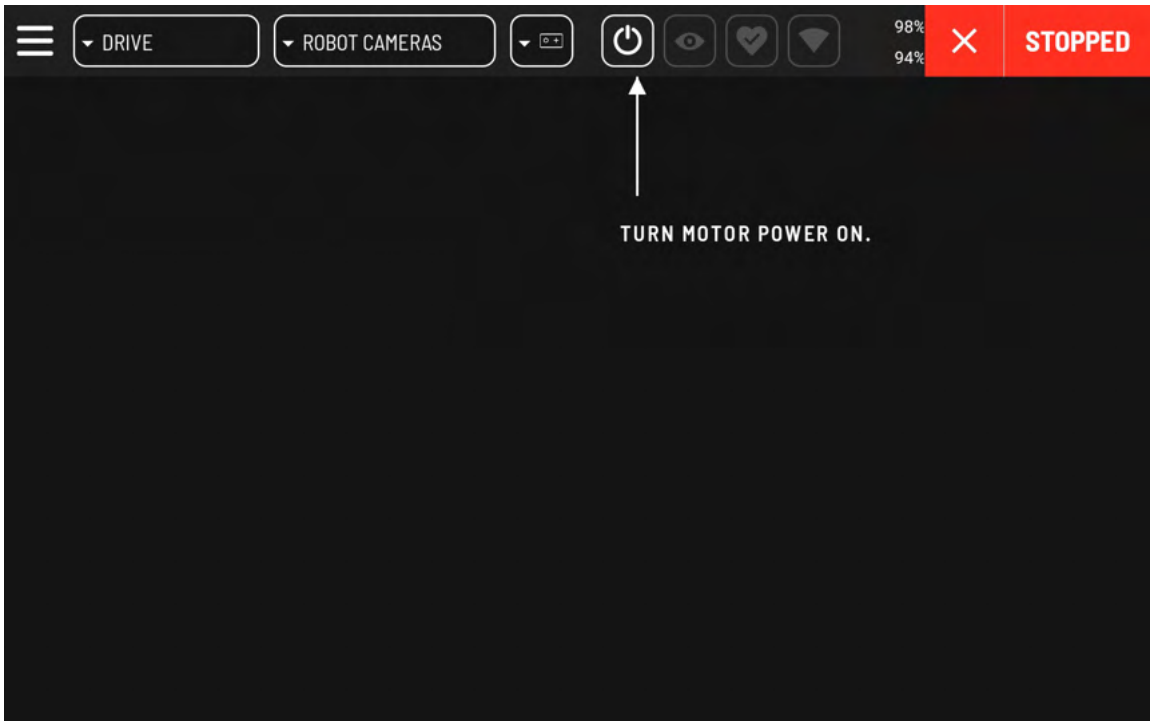
WARNING

When motors are de-energized, Spot will lose its ability to stand and balance. On flat ground, Spot will lower its body. On inclined surfaces or stairs, Spot may tip over.

5.4.2. Restarting after a stop using the tablet controller

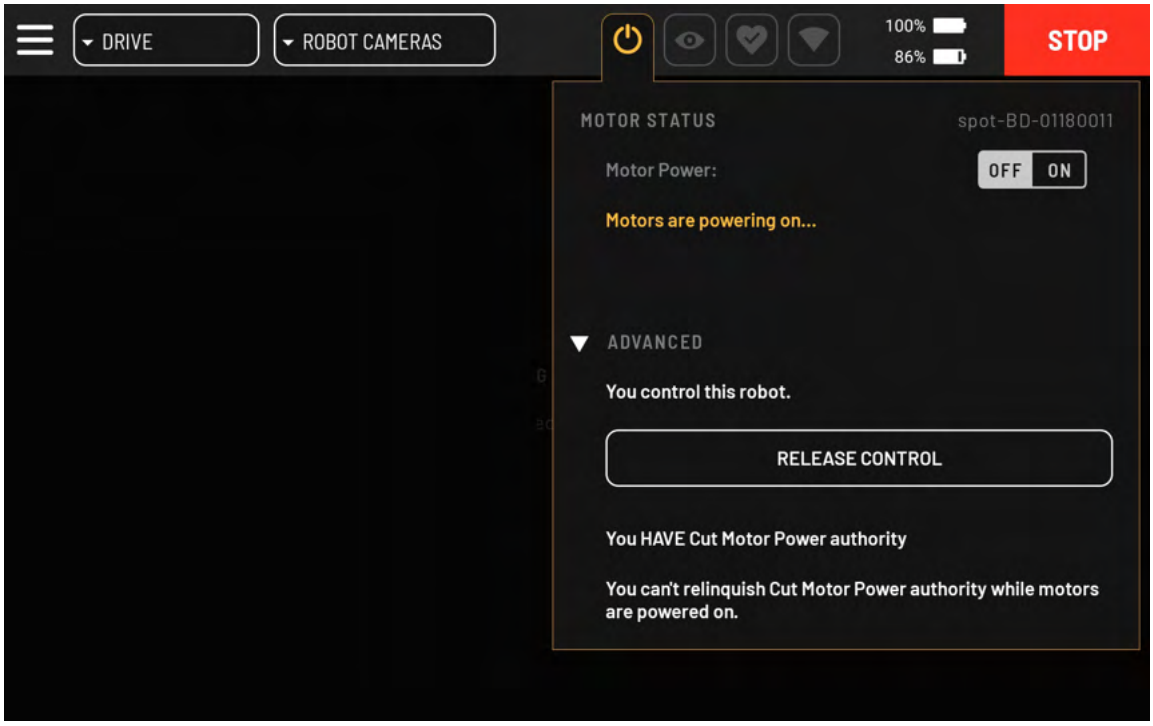
To resume operation with the tablet controller after a stop:

1. First make sure safety conditions are met, and sufficient clearance is maintained.
2. Select the red ✕ to clear the stop.



Tablet controller during a stop.

3. Open the Motor status panel and toggle **Motor Power** to **ON**.



Tablet controller Motor status panel.

4. Resume operation. If Spot continues to stop unexpectedly, contact Boston Dynamics Support.

5.5. Changing Spot's mode of operation

In most situations, Spot can be switched between manual and automatic modes of operation without powering off motors.

If Spot is running an Autowalk mission unsupervised or under the supervision of another remote controller, you will be prompted to power off and restart Spot's motors as part of the mode change.

CAUTION

Changing modes will bring any current robot motion to a standstill, and may cause Spot to immediately begin moving along a new trajectory.

5.5.1. Switching to automatic mode

Spot enters automatic mode whenever it begins to replay an Autowalk mission, or whenever AutoReturn is triggered. This may be the result of:

- A direct command from an Operator.
- A mission that was scheduled to run at a specific time.
- A command from software running on Spot, an attachment, or an external networked device such as a computer or server.
- Signal loss between Spot and a remote controller, if Spot is configured to use AutoReturn.

Spot remains in automatic mode during a mission and between looping or scheduled missions, including while stationary or docked, until any of the following occurs:

- The Autowalk mission ends, and there is no looping or scheduled mission pending.
- Spot is stopped by any stopping function described in 2.5: Stopping functions.
- Spot receives a command to switch to manual mode as described in 5.5.2: Switching to manual mode.
- Spot regains its connection to a remote controller as a result of AutoReturn.
- Spot is powered off.

NOTICE

While in automatic mode, Spot's motors may start automatically, remain started, or re-start automatically. For more information, see 5.3.3: Start Spot's motors and 5.8: Automatic operation.

5.5.2. Switching to manual mode

Spot enters manual mode whenever an Operator takes direct control of Spot via a remote controller. This may be the result of:

- Connecting a remote controller to Spot and issuing a start command as described in 5.3.3: Start Spot's motors.
- Pausing an Autowalk mission replay, for instance by selecting **Pause** ⏸ on the tablet controller.
- Exiting Autowalk mode, for instance by selecting **EXIT AUTOWALK** on the tablet controller.
- Canceling an upcoming scheduled mission, for instance by selecting **CANCEL MISSION** on the tablet controller.
- A restored connection between Spot and a remote controller as a result of AutoReturn.

Spot will remain in manual mode until it is switched to automatic mode or powered off, or until AutoReturn is triggered.

5.6. Docking and undocking Spot

During docking, Spot:

1. Orients itself in front of the Spot Dock with its rear facing the dock.
2. Walks backward to position itself over the dock.
3. Aligns its body with dock fixtures.
4. Lowers its body to connect to the charging pins on the rear tower.
5. Lifts its legs and powers off its motors.

During undocking, Spot:

1. Starts its motors, if they are not already started.

2. Slowly unfolds and lowers its legs, then stands up.
3. Walks forward until its rear legs are clear of the Spot Dock.

Spot uses its perception system to recognize the Spot Dock and navigate automatically during docking and undocking.

NOTICE

Before docking or undocking Spot, ensure that the Spot Dock has been installed correctly and is in usable condition. See 4.4: Spot Dock setup.

The Spot Dock may become damaged during docking and undocking. Periodically check the dock for signs of damage, including the pins that connect Spot to power and Ethernet.

CAUTION

Do not operate Spot with a visibly damaged Spot Dock. For details on what to do with a damaged dock, refer to *Spot Dock Information for Use* in the Boston Dynamics Support Center (see 8: Appendix A: Supplemental information.

Docking and undocking involve automatic robot locomotion and physical contact between Spot and the Spot Dock.

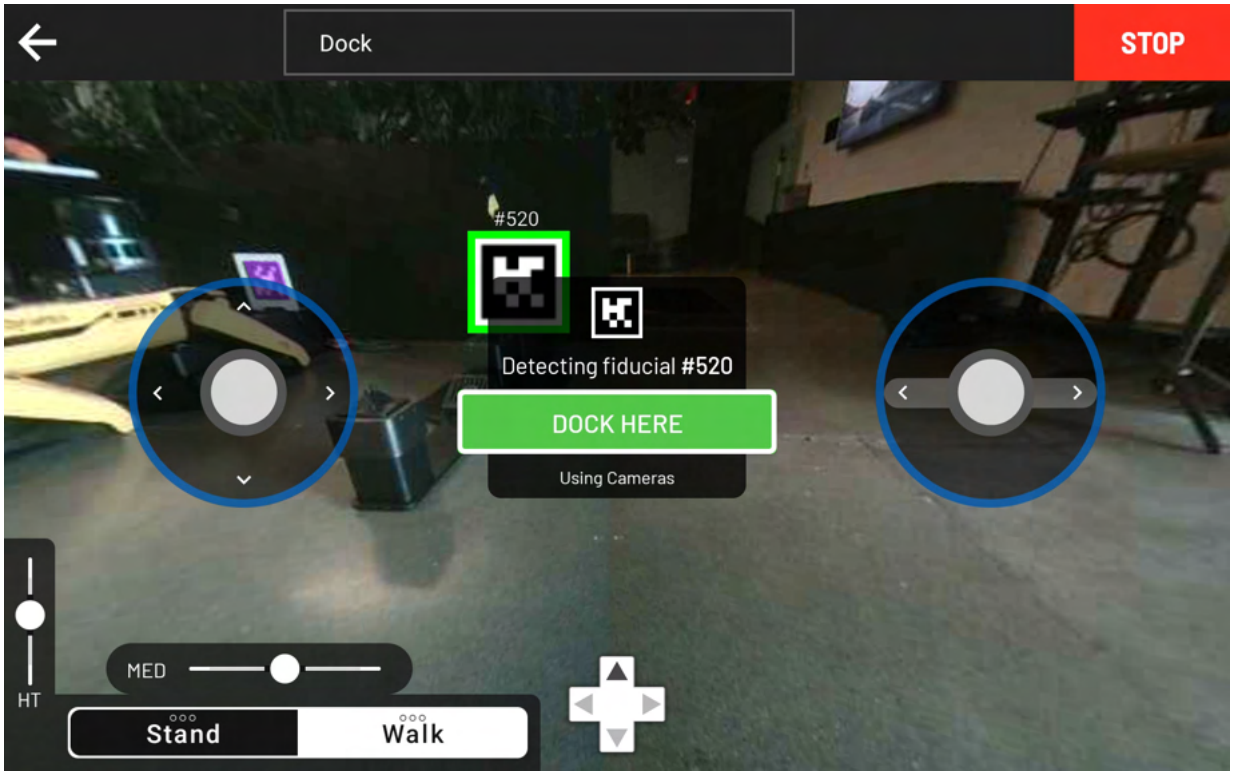
WARNING

- Spot could trip on the Spot Dock and fall.
- The layout of the Spot Dock and its surroundings (e.g. inclines, etc.) could cause Spot to be unstable.
- In case of a fall or lateral displacement, sensitive equipment could be damaged.

Ensure the area around the Spot Dock is clear and remove any sensitive electrical equipment.

Do not try to recover Spot from any instability. Do not approach Spot in any circumstance to attempt any troubleshooting during docking and undocking.

5.6.1. Docking and undocking in manual mode



Docking Spot with the tablet.

To dock Spot using the tablet controller:

1. Drive Spot toward an unoccupied Spot Dock.

> **CAUTION**
> Ensure that you have a clear and complete view of the surroundings of the Spot Dock. If your ability to observe the operation remotely is compromised, abort docking.

2. When Spot is close enough, the dock fiducial will be highlighted in purple on the controller screen. Generally, this happens within 4 meters of the dock.
3. On the controller, select **Add Action**.
4. Select **ACTIONS** > **Dock**.
5. Select the docking fiducial, which will now be highlighted in green.
6. Select **DOCK HERE**.
7. Spot will automatically dock.

To undock Spot using the tablet controller:

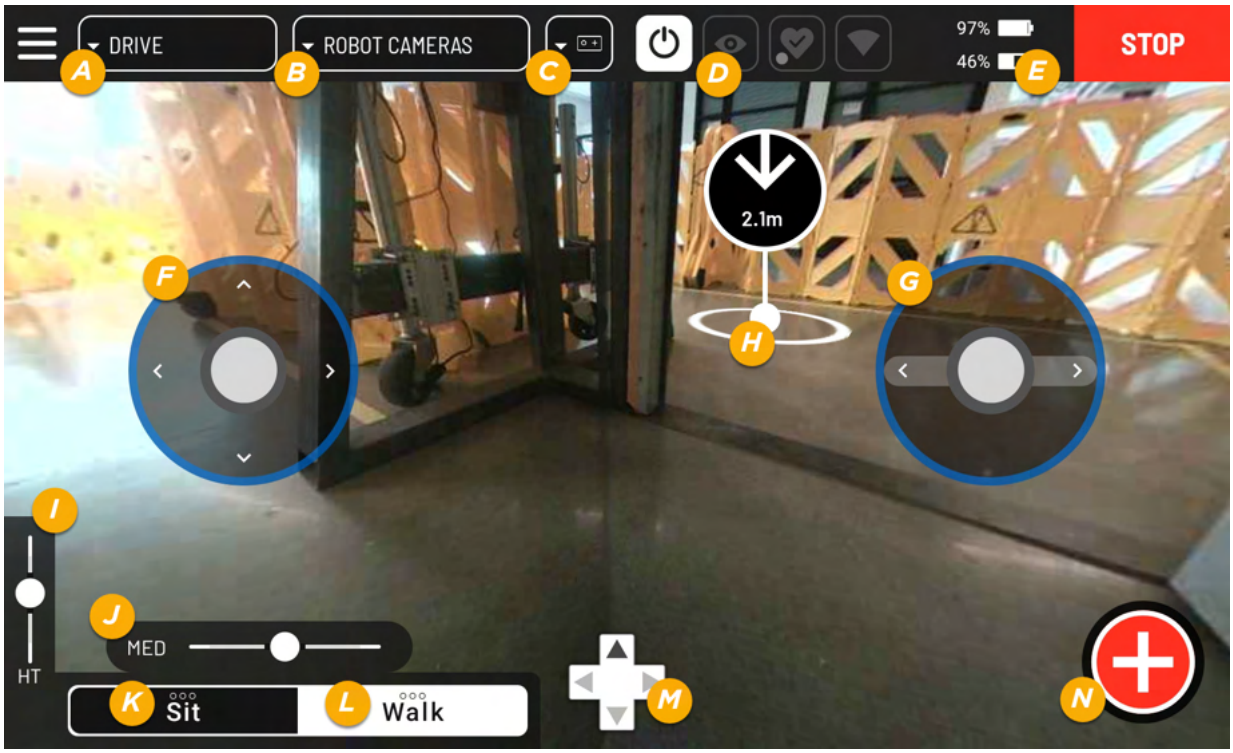
1. Select the Undock button.
   - If Spot's motors are running, the undocking button reads: **UNDOCK**
   - If Spot's motors are off, the undocking button reads: **POWER ON & UNDOCK**

2. Spot will automatically undock.

5.7. Driving with remote control

When driving with remote control, you are in direct control of Spot's movements and behaviors.

5.7.1. Tablet controls (Drive mode)

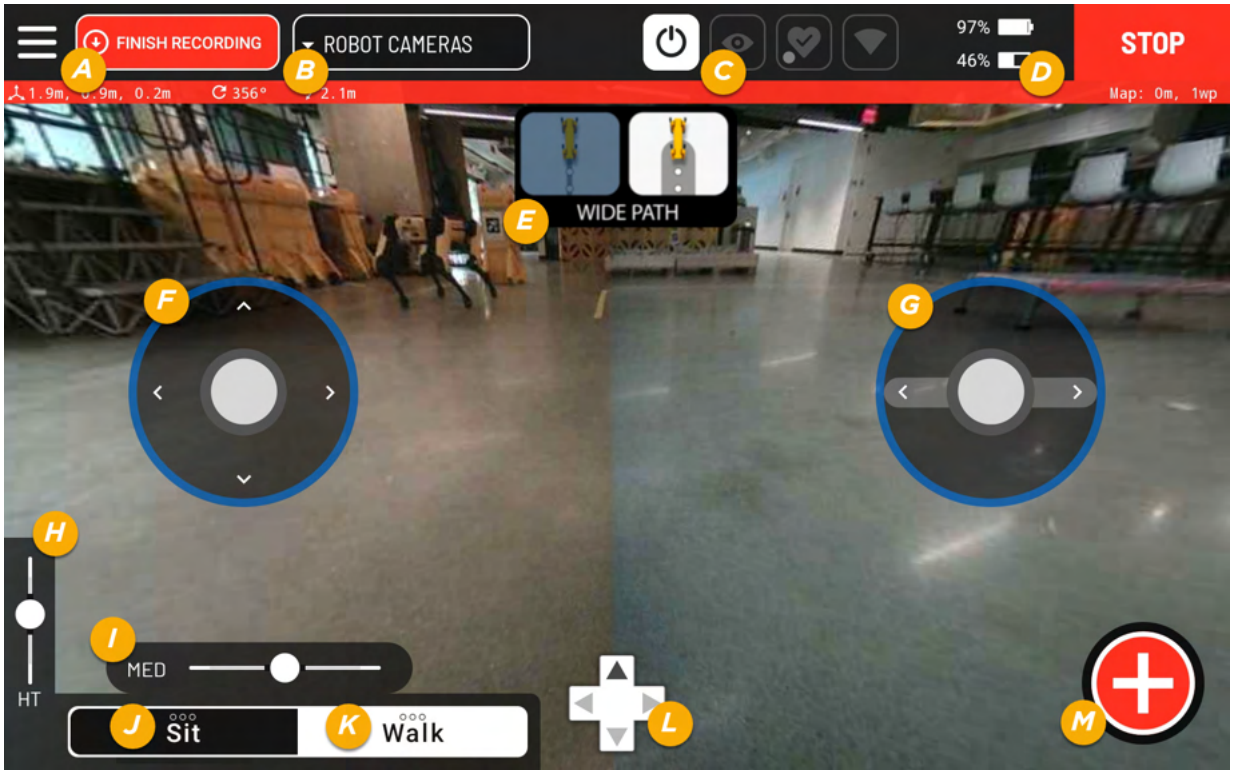


Tablet Drive mode controls.

Label	Control	Description
A	Modes dropdown	Select **DRIVE** to switch Spot between Drive mode, Autowalk mode, and other modes.
B	Cameras dropdown	Select from available camera views. Some views enable joystick controls, others enable Touch-to-Go controls.
C	Controls dropdown	Select the gamepad to drive with joysticks. Select the hand to drive with Touch-to-Go.
D	Perception status panel	Open, then use the **Obstacle Avoidance Cushion** slider to adjust how much distance Spot will try to keep between itself and obstacles.
E	Battery status panel	Open, then select **ROLL OVER**: Spot sits and rolls onto its side, exposing the battery compartment.

Label	Control	Description
F	Left joystick	Move Spot forward, backward, left, and right.
G	Right joystick	Rotate Spot clockwise or counterclockwise.
H	Touch-to-Go	Spot will walk to the location you select. Select ⊗ to cancel.
I	Height slider	Adjust Spot's walking height.
J	Speed slider	Switch between three maximum speed settings (**SLOW**, **MED**, **FAST**).
K	Pose selector	Long-press, then select an option: • **Sit**: Spot lowers its body to the ground. • **Stand**: Spot stands in place. Joysticks control height, roll, pitch, and yaw. • **Self Right**: Spot attempts to reach a sitting position with its body flat on the ground, moving its legs and body as needed to flip or reorient itself.
L	Gait selector	• Long-press on the right, then select **Walk** (regular speed) or **Crawl** (slow speed) to enable movement controls.
M	Directional arrows	Switch camera views.
N	**Add Action** ⊕	Perform programmable behaviors like capturing an image or docking with a Spot Dock.

5.7.2. Tablet controls (Autowalk mode)



Tablet Autowalk mode controls.

Label	Control	Description
A	Finish recording	End recording and save the mission.
B	Cameras dropdown	Select from available camera views.
C	Perception status panel	Open, then use the **Obstacle Avoidance Cushion** slider to adjust how much distance Spot will try to keep between itself and obstacles.
D	Battery status panel	Open, then select **ROLL OVER**: Spot sits and rolls onto its side, exposing the battery compartment.
E	Path following tolerance	Determine how closely Spot should adhere to the recorded mission route on replay. This setting is recorded separately for each path segment. • **WIDE PATH** (default): Spot may deviate up to 1.5 meters from the recorded mission route to avoid obstacles. • **STRICT PATH**: Spot will adhere closely to the recorded mission route, keeping the center of its body within a 25 cm corridor along the recorded path.

Label	Control	Description
F	Left joystick	Move Spot forward, backward, left, and right.
G	Right joystick	Rotate Spot clockwise or counterclockwise.
H	Height slider	Adjust Spot's walking height.
I	Speed slider	Switch between three maximum speed settings (**SLOW**, **MED**, **FAST**).
J	Pose selector	Long-press, then select an option: • **Sit**: Spot lowers its body to the ground. • **Stand**: Spot stands in place. Joysticks control height, roll, pitch, and yaw. • **Self Right**: Spot attempts to reach a sitting position with its body flat on the ground, moving its legs and body as needed to flip or reorient itself.
K	Gait selector	• Long-press on the right, then select **Walk** (regular speed) or **Crawl** (slow speed) to enable movement controls.
L	Directional arrows	Switch camera views.
M	**Add Action**	Perform programmable behaviors like capturing an image or docking with a Spot Dock.

5.7.3. Recording an Autowalk mission

Autowalk missions must be recorded manually using the tablet. During recording, Spot creates a map of the route you drive and any Actions you perform along the way.

NOTICE

Many incidental operations during recording, such as standing idle or switching camera views, are not included in the mission map and will not be repeated by Spot during replay.

To start a mission recording, at least one fiducial marker must be placed in the operating environment.

To record a mission:

1. On the tablet, open the Modes dropdown and select **AUTOWALK**.
2. Select **RECORD**.
3. Select **START RECORDING**.
4. Drive Spot and perform Actions.

5. Select **FINISH RECORDING**, then select **YES**. The mission is stored on the tablet.

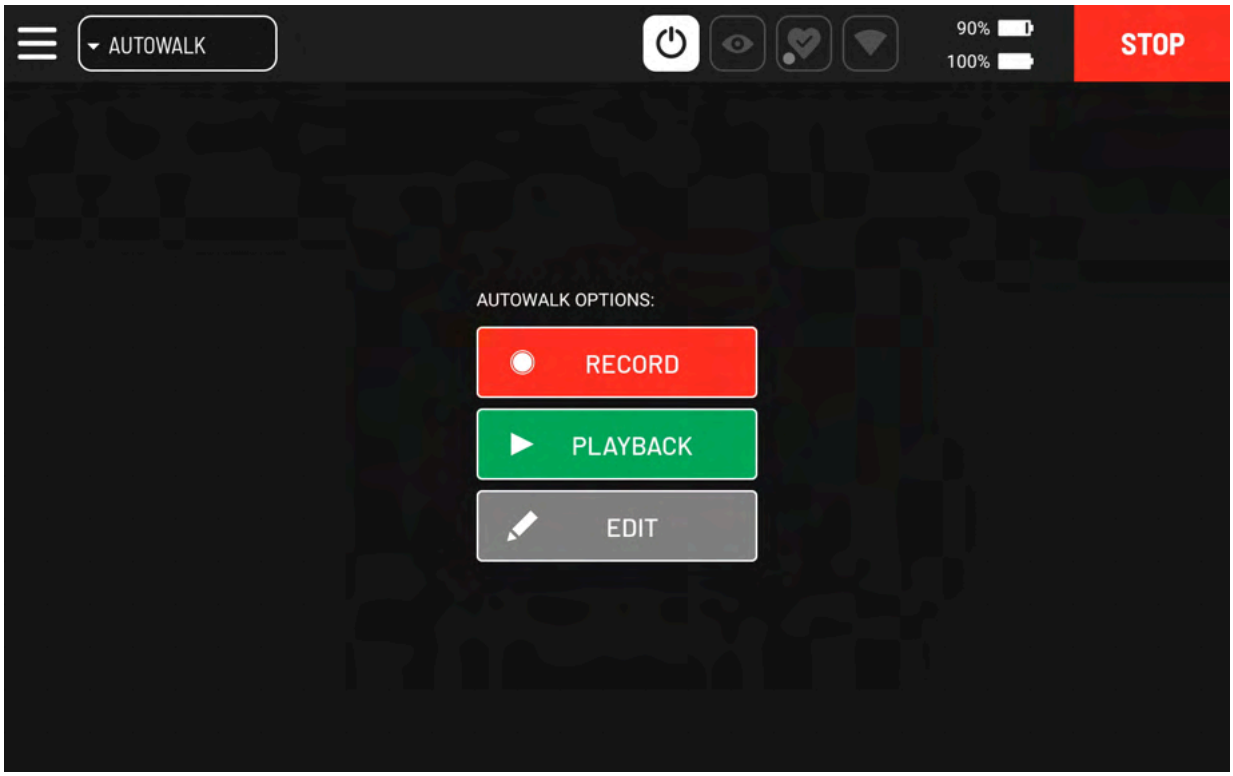
To extend a previously recorded mission:

1. Replay the mission as described in 5.8.1: Replaying an Autowalk mission.
2. Select **Pause** ⏸ at the point where you want to extend the mission route or add Actions.
3. Select **EXTEND MISSION**.
4. When prompted, select **EXTEND MISSION**.
5. Drive Spot and perform Actions.
6. Select **FINISH RECORDING**, then select **YES**. The extension is added to the mission.

5.8. Automatic operation

During automatic operation, Spot follows the route set by a pre-recorded Autowalk mission, performs Actions, and attempts to resolve navigation challenges according to mission replay settings.

5.8.1. Replaying an Autowalk mission



The Autowalk main screen.

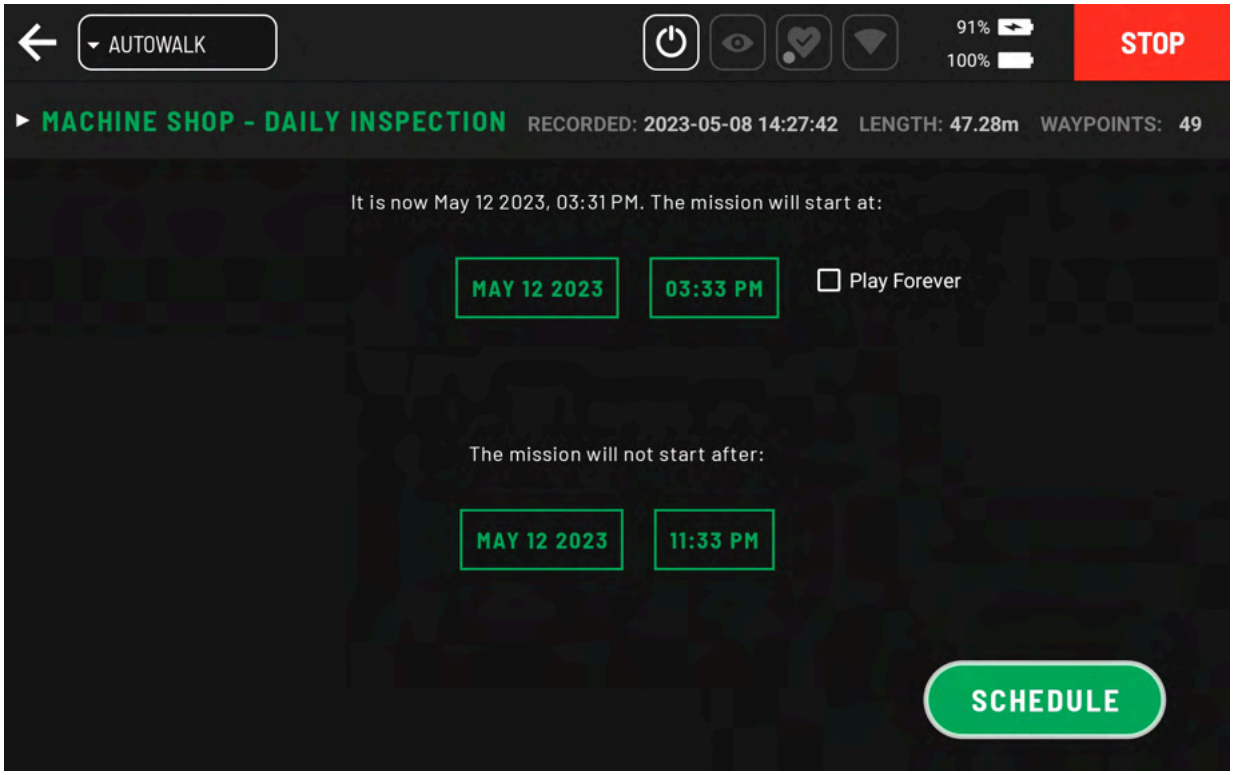
To replay an Autowalk mission from the tablet:

1. If the mission begins or ends at a Spot Dock, ensure Spot is on the dock. Otherwise, ensure Spot is within sight of at least one fiducial that was recognized during mission recording.
2. Open the Modes dropdown and select **AUTOWALK**.
3. Select **PLAYBACK**.

4. Select a mission to replay, then select **CONTINUE**.
5. Confirm Action and route parameters, then select **CONTINUE**. For details on these settings, see 5.8.3: Configuring Autowalk mission replay options.
6. Confirm mission replay options:
   a. For details on these settings, see 5.8.3: Configuring Autowalk mission replay options.
   b. Check the Supervision setting. For details, see 5.8.4: Autowalk replay supervision.
   c. When finished, select **PLAY NOW**.
7. If prompted, select **INITIALIZE**.
8. Select **Play** ⓟ. Spot carries out the mission.

5.8.2. Scheduling Autowalk mission replays

Autowalk missions can be scheduled in advance and set to run on a recurring basis. To be eligible for scheduling, the mission must end with a docking Action.



Scheduling an Autowalk mission.

To schedule a mission replay using the tablet controller:

1. Ensure Spot is on the same Spot Dock where the mission recording ends.
2. Follow steps 2 through 6 as described in 5.8.1: Replaying an Autowalk mission. At the end of step 6, select **PLAY LATER**.
3. Enter the date and time when the mission will begin. If the mission is configured to loop, enter an end time or select **Play forever**.
4. Select **SCHEDULE**.

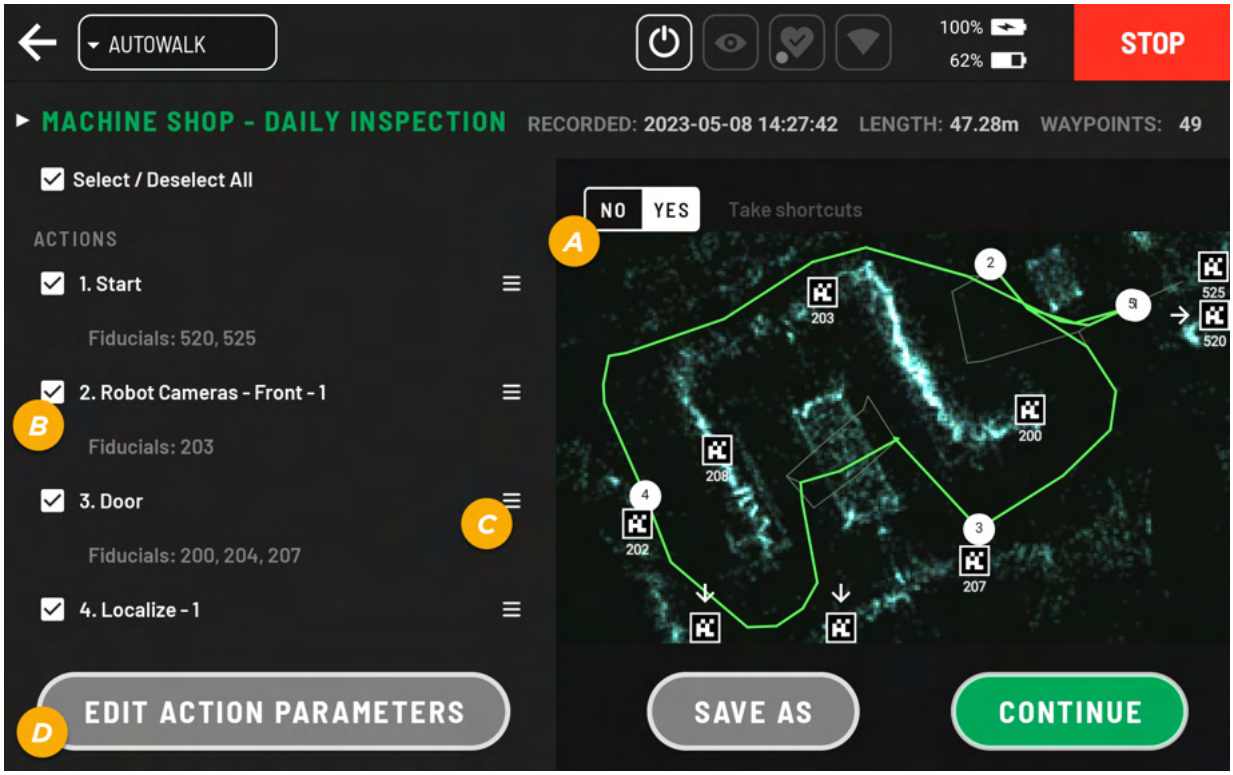
5. A countdown to the next scheduled mission start appears. At the scheduled time, Spot carries out the mission.

To cancel a scheduled mission:

1. Select **CANCEL MISSION**.
2. Select **YES** to exit Autowalk mode.

5.8.3. Configuring Autowalk mission replay options

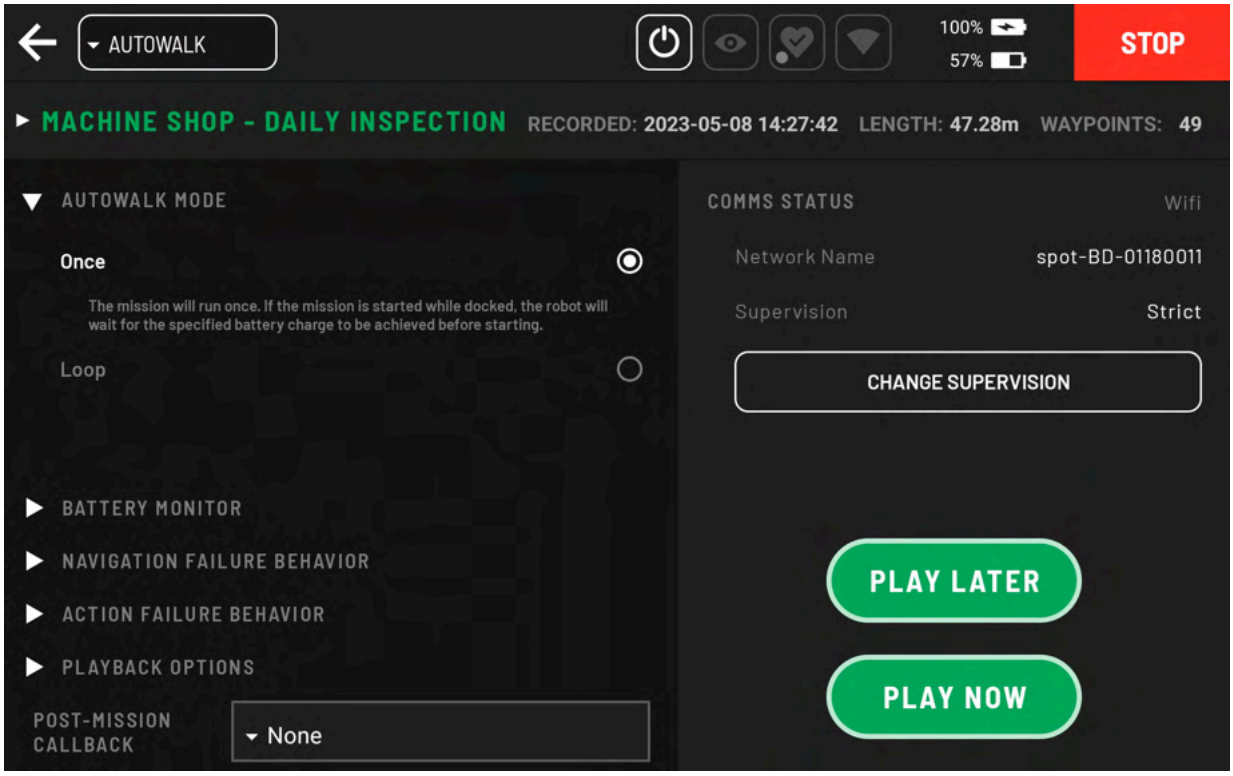
Mission replay options modify Spot's behavior as it carries out an Autowalk mission. Options are configured on the tablet at the time playback is initiated.



Autowalk mission route preview.

Label	Control	Description
A	Take shortcuts	To use the most efficient mission route that includes all enabled Actions, set **Take shortcuts** to **YES**. Otherwise, Spot will follow the mission route as recorded.
B	Enable/Disable Actions	To enable or disable an Action, toggle its checkbox. Disabled Actions will be skipped during replay.
C	Re-order Actions	Drag-and-drop to change the order in which Actions will be performed. This may cause Spot to backtrack along the mission route.

Label	Control	Description
D	Edit Actions	If an Action includes parameters that can be edited after recording, select **EDIT ACTION PARAMETERS** to modify those settings.



Autowalk mission replay options.

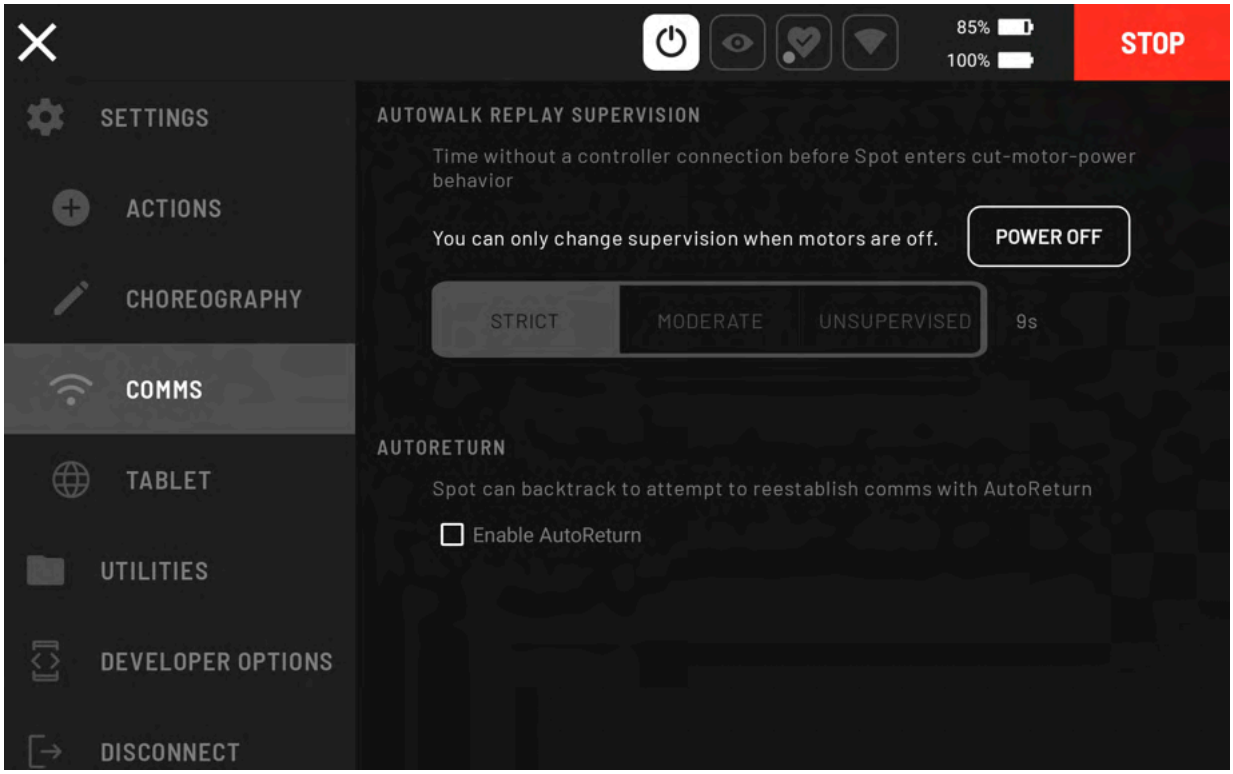
Option	Description
AUTOWALK MODE	
Once	The mission will run once.
Loop	The mission will run repeatedly at the specified time interval.
BATTERY MONITOR	
Minimum charge for undocking	Spot will wait for the specified battery charge to be achieved before starting the mission.
Charge to return to dock	During a mission, if the battery charge is running low, Spot can return to the dock automatically to recharge before finishing the mission.
NAVIGATION FAILURE BEHAVIOR (see 5.8.5: Mission prompts and Operator intervention)	

Option	Description
Prompt Timeout	If no operator responds to the prompt within the allotted time, the mission will continue automatically.
Automatic Retries	When a prompt times out, Spot will attempt navigation again until it either succeeds or reaches the specified retry limit.
Navigation failure behavior	When there are no more retries, Spot will perform the specified operation.
ACTION FAILURE BEHAVIOR (see 5.8.5: Mission prompts and Operator intervention)	
Prompt Timeout	If no operator responds to the prompt within the allotted time, the mission will continue automatically.
Automatic Retries	When a prompt times out, Spot will attempt navigation again until it either succeeds or reaches the specified retry limit.
Navigation failure behavior	When there are no more retries, Spot will perform the specified operation.
PLAYBACK OPTIONS	
Replace Actions with short sleeps	Spot will walk the mission route, but no Actions will be performed. Useful for confirming Spot's ability to navigate the mission route, and when extending previously recorded missions.
Enable strict path following	If this box is checked, Spot will attempt to follow the recorded path exactly without navigating around obstacles, even for parts of the mission route where wide path following was enabled during recording.
Patience	If people or other obstacles are blocking the mission route, Spot will wait for the specified interval before attempting to reroute.
Enable ground clutter avoidance	If checked, Spot will attempt to detect and avoid low obstacles during playback, unless the objects were stepped on during mission recording. If this box is unchecked, Spot may step on or over low obstacles.
Goal radius	Spot will perform each Action when it is within the specified radius of the location where the Action was recorded. Useful if Spot frequently gets stuck trying to reach the Action location and the Action doesn't require precise positioning.
Automatic Self Rights	When Spot falls, it can autonomously self-right. To prevent Spot from falling repeatedly, you can cap the number of times this happens. See also: 5.8.5: Mission prompts and Operator intervention

5.8.4. Autowalk replay supervision

By default, Spot maintains a connection to a remote controller while operating automatically. This allows you to monitor automatic operation and intervene when necessary to ensure safety or help Spot overcome navigation challenges that are preventing it from completing a mission (see 5.8.5: Mission prompts and Operator intervention).

The Autowalk replay supervision setting determines how long Spot can continue operating in automatic mode without a connection to a remote controller. After the set duration, Spot will sit and power off its motors as described in 2.5.1: Operational stop.



Autowalk replay supervision settings.

Supervision setting	Duration of automatic operation
STRICT (default)	9 seconds
MODERATE	30 seconds
UNSUPERVISED	18.2 hours

WARNING

When Spot is operating "Unsupervised", it may not be possible to stop Spot quickly. Use this setting only after carefully assessing the operating environment and the risks of unsupervised operation.

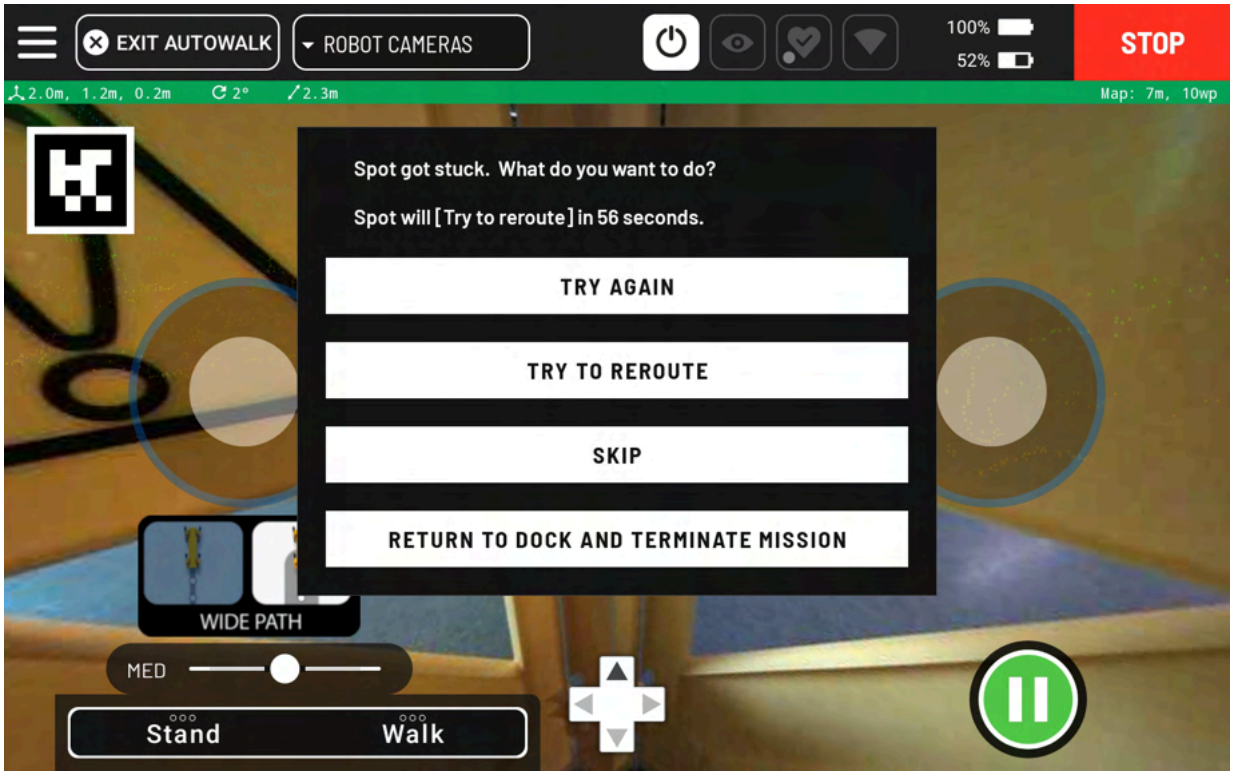
To change Autowalk replay supervision:

1. On the tablet controller, Navigate to **Menu ≡** > **SETTINGS** > **COMMS**.
2. If Spot's motors are running, select **POWER OFF**.
3. Select a supervision setting.

5.8.5. Mission prompts and Operator intervention

Spot may prompt you for input during automatic operation, for instance to respond to a navigation challenge which is preventing it from progressing in a mission.

If you don't respond to the prompt, Spot will abort or continue the mission according to the mission replay options. Prompt timeouts and Spot's behavior if no input is received are configurable as described in 5.8.3: Configuring Autowalk mission replay options.



Autowalk mission prompt asking for Operator input.

Mission prompt response	Description
TRY AGAIN	Spot will attempt to continue along the mission route. If the obstacle has been removed, the mission will continue as recorded.
TRY TO REROUTE	Spot will attempt to compute an alternate path to the next Action based on the recorded mission route. If successful, Spot will continue the mission.

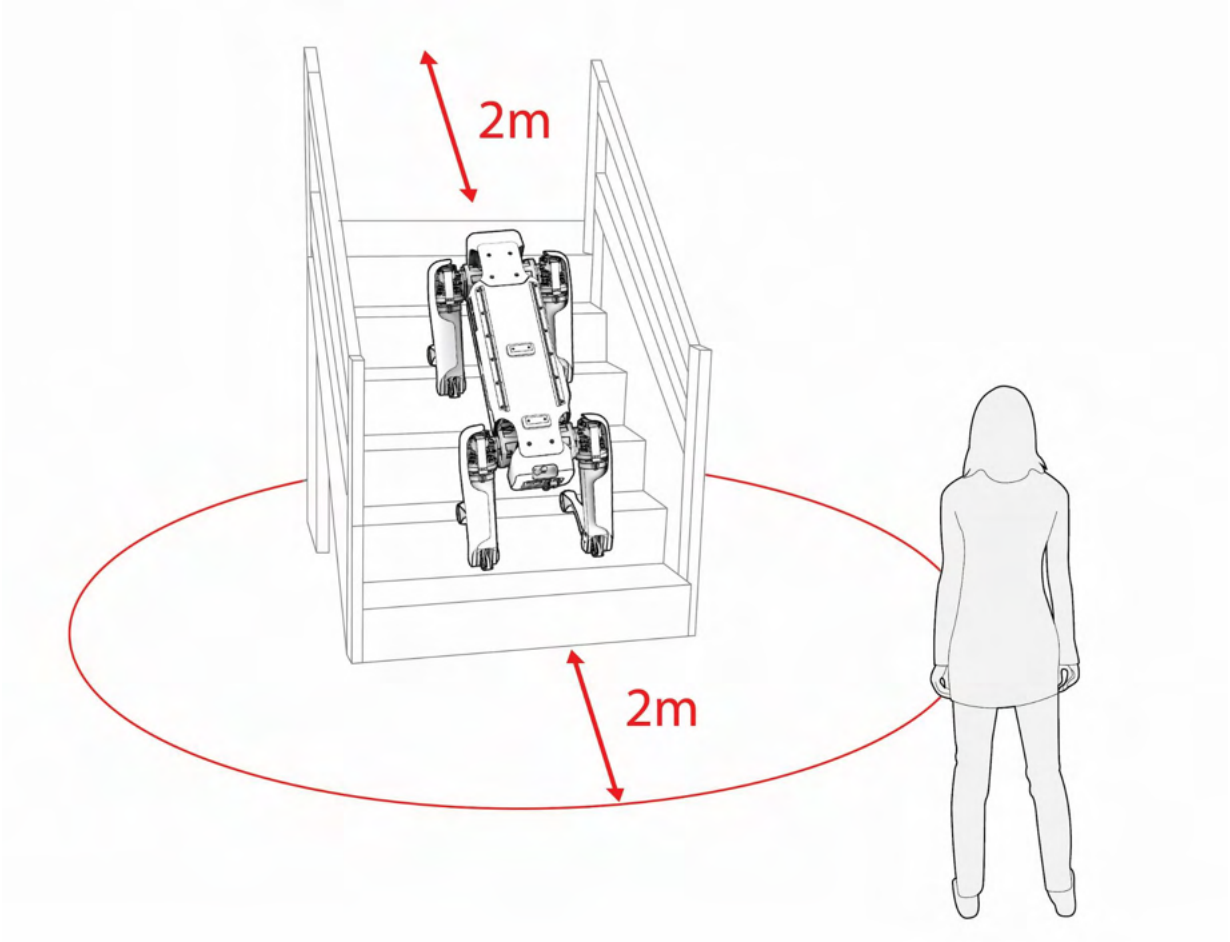
Mission prompt response	Description
SKIP	Spot will skip the next Action and attempt to continue the mission by performing any subsequent Actions.
RETURN TO DOCK AND TERMINATE MISSION	Spot will immediately return to the dock and abort the mission.

5.9. Navigating stairs

Stairs are very particular environments that can be shared by both Spot and humans. Staircases are always associated with fall hazards and residual risks. You must review the layout and restrict access to areas with stairs as much as practically possible as part of the risk assessment (see 2.9: Risk assessment) and mark the areas with visual signs.

When manually controlling Spot on stairs or recording an Autowalk mission that includes stairs, follow these instructions for safely climbing and descending stairs:

1. To climb stairs, position Spot at the base of the staircase, and push the Left joystick forward to walk Spot straight up the stairs.
2. To descend stairs, always operate Spot in reverse, pushing the Left joystick backward so that Spot descends rear-first.



Stair safety.

The following conditions and/or actions are critical for safe stairway navigation and must be checked whether manually controlling Spot or recording/replaying an Autowalk mission:

- Grated stairs, open-riser stairs, or partially transparent stairways pose significant perception challenges during stair locomotion.
- Spot should always descend stairs rear-first.

DANGER

Spot could fall from stairs and cause personal injuries or material hazards.

Do not stand beneath or downhill of Spot when it is on an elevated surface, such as a staircase or elevated platform. Stay at least 2 meters away from the bottom of any staircase or incline where Spot is active.

When manually controlling Spot or recording an Autowalk mission:

- Position yourself at the top or 2 meters away from the bottom of the staircase before driving Spot onto the stairs.
- Do not follow Spot up the stairs until it has come to a standstill on a flat landing with sufficient clearance.
- Avoid turning Spot on stairs. Wait for Spot to reach a complete landing and secured zone before turning.
- Do not attempt to climb stairs by side-stepping.

5.10. Recovering from a fall

WARNING

Before recovery, perform a risk assessment of any conditions in the environment which may have contributed to the fall and/or could potentially make Spot fall again.

To help Spot recover from a fall during remote controlled or manual operation:

1. Wait for Spot to come to a complete stop.
2. Check for visible damage to Spot's legs, actuators, battery, and battery compartment. If any of these components appear damaged, cease operation immediately and contact Boston Dynamics support. If Spot is only cosmetically damaged or appears undamaged, continue with this procedure.
3. If Spot is resting stably on a level surface:
    a. Clear a 1-meter radius around Spot.
    b. Follow the instructions in 5.4.2: Restarting after a stop using the tablet controller.
    c. Activate **Self Right** as described in 5.7: Driving with remote control.
4. If Spot is not resting stably on a level surface or if Spot fails to self-right:
    a. Press the motor lockout button.
    b. Move Spot by hand so it is resting stably on a level surface in the "sit" position.
    c. Reset the motor lockout as described in 5.3.2: Reset the motor lockout.
    d. Follow the instructions in 5.4.2: Restarting after a stop using the tablet controller.

5. As you resume operation, watch for erratic or unexpected behavior that could indicate damage. If you suspect Spot is damaged, cease operation immediately and contact Boston Dynamics support.

5.11. Turning off Spot

When you are finished operating Spot, return it to a Spot Dock as described in 5.6: Docking and undocking Spot or follow the procedure below.

To turn Spot off:

1. Drive Spot to a charging, storage, or transport location. Drive Spot instead of carrying it whenever possible.
2. Sit Spot.
3. Open the Motor status panel and toggle **Motor Power** to **OFF**.
4. Press Spot's motor lockout button. This will set the motor lockout.
5. Power off Spot by pressing and holding the power button for two seconds.
6. On the tablet controller, open the **Menu** ☰ and select **DISCONNECT**, then select **SIGN OUT**.
7. Connect Spot to the Spot Power Supply to charge the battery in the robot, or remove the battery and charge it with the Spot Power Supply.

> **NOTICE**
> Always remove the battery when Spot is not in use unless Spot is connected to the Spot Power Supply or sitting on a powered Spot Dock. Batteries left in Spot while not in use will continue to discharge, even when Spot is powered off. Batteries left in a powered off robot for more than 24 hours may be damaged beyond repair.

5.12. Recommended practices during Spot operation

When you are near Spot during robot operations, observe the following precautions:

- Stay at least 2 meters away from Spot at all times.
- Always give Spot the right of way, especially during automatic operation.
- Do not stand beneath or downhill of Spot when it is on an elevated surface, such as a staircase or elevated platform. Stay at least 2 meters away from the bottom of any staircase or incline where Spot is active.
- Do not enter a staircase where Spot is active. If Spot enters a staircase you are already using, move upwards to a landing where there is sufficient space for Spot to pass.
- Do not enter confined spaces where Spot is active, such as hallways, if there is not sufficient space to pass or avoid Spot.
- Do not touch, move, power off, or otherwise interact with Spot when you are not operating it, even if Spot appears inactive.

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- Do not move, alter, damage, or block fiducials.
- Do not intentionally block mission paths, place objects in Spot's way, or otherwise alter the operating environment in ways that deliberately interfere with robot operation.

6. Maintenance

6.1. Service and repair

Do not attempt to service or repair Spot yourself. If errors or other issues persist during robot operation, Spot may need attention from Boston Dynamics Support engineers. Include the following information when contacting Support:

- Spot serial number
- Description of the issue

To contact Boston Dynamics Support, visit: https://support.bostondynamics.com/s/contactsupport.

6.2. Cleaning and maintaining Spot

Spot requires regular cleaning and basic preventive maintenance. While conducting cleaning or maintenance operations, always follow safe handling guidance as described in 3.2: Safe handling.

DANGER

Damage or ingress of foreign objects to charging ports and connectors may result in electrical hazards. Do not operate Spot or plug in any electrical equipment to Spot if there is visible damage or foreign objects are present.

CAUTION

- Dirty or damaged camera windows may impair Spot's obstacle detection and navigation capabilities, and may prevent remote Operators from assessing the condition of the environment around Spot. Do not operate Spot if cameras are obscured or damaged.
- Damage to Spot's legs or ingress of foreign objects to Spot's joints may result in unpredictable motion and falls. Do not operate Spot if legs are damaged or foreign objects have infiltrated Spot's joints.
- Worn foot treads may result in an increased chance of slips and falls, especially on low-friction surfaces. Regularly inspect Spot's foot treads and replace any that show excessive wear.
- Turn Spot off before touching it or performing maintenance inspections.

6.2.1. Exterior cleaning

When cleaning Spot's exterior:

- Use a non-abrasive cloth dampened with glass cleaner to clean camera windows.
- Use a magic eraser or a mild detergent to clean superficial scuffs on Spot's body or leg panels.
- Do not use bleach.
- Do not use strong solvents.
- Do not submerge Spot. Spot is resistant to light sprays of water but should not be sprayed forcibly with water jets or submerged in water. Submerging Spot will permanently damage it.
- Consider purchasing new body panels if they become overly damaged/scuffed.

6.2.2. Preventive maintenance

Performing monthly inspections for Spot will help to identify preventative maintenance items for successful and safe operation. For example, if Spot's cooling fans are clogged with dirt, an overheating fault may be generated and Spot may not be safe for operation.

If any damage is found during periodic inspection, contact Boston Dynamics Support.

6.3. Recalibration with SpotCheck

SpotCheck is a self-calibration routine for Spot's joints and cameras. If Spot starts behaving erratically, SpotCheck can evaluate and resolve calibration issues to restore normal locomotion and perception accuracy.

Falls and regular usage over time can cause Spot's cameras or joints to become misaligned. An uncalibrated Spot is more likely to experience failures such as falling or erroneous obstacle detection.

Any of the following behaviors may be a sign that recalibration is necessary:

- Spot limps or stumbles more than usual.
- Spot runs into obstacles it has successfully avoided in the past.
- Spot has more difficulty on stairs than usual.

For instructions on running SpotCheck, refer to documentation in the Boston Dynamics Support Center (see 8: Appendix A: Supplemental information).

CAUTION

Prepare a dedicated restricted area for executing SpotCheck. Review the calibration procedure. Spot movements during SpotCheck are different from those experienced during normal operations.

7. Declarations and marking

7.1. EU Declaration of Incorporation

Manufacturer
Boston Dynamics, Inc. 200 Smith Street Waltham, MA 02451 USA

Person authorised to compile the Technical File, established in the Community
Alura Group BV Kroonwiel 2 6003 BT Weert The Netherlands

Description and identification of the machinery		
Description and identification of the machinery		
Product and function: General purpose legged robot (multiple-axes machine that uses articulated limbs for locomotion) intended for professional use in either industrial, restricted, or controlled environments. The robot's function as a complete machine may be determined by its attachments, environment, and intended application.		
Designation		
Spot	Model: 04-00143531-001	s/n: BD-<Y><#######> Y = last digit of the year ######## = 31640001 or higher

Declarations
It is declared that the above product, for what is supplied, shall only be put into service upon being integrated into a final complete machine (robot application), which conforms with the provisions of the Machinery Directive 2006/42/EC as amended (“MD”) and other applicable Directives. The following Essential Health and Safety Requirements (EHSR) and supplementary requirements of Annex I of the MD have been applied and fulfilled: 1.1.2, 1.1.3, 1.1.5, 1.2.1, 1.2.2, 1.2.3, 1.2.4.1, 1.2.4.2, 1.3.2, 1.3.4, 1.3.7, 1.5.1, 1.5.2, 1.5.6, 1.5.7, 1.5.10, 1.5.11, 1.5.12, 1.6.1, 1.6.3, 1.7.1, 1.7.2, 1.7.3, 1.7.4, 3.3.2, 3.3.4, 3.5.1. It is declared that the relevant technical documentation has been compiled in accordance with Part B of Annex VII of the MD.
Conformity to other Directives. It is declared that the product, for what is supplied, fulfills all the relevant provisions of the following directives, according to which the product is CE marked: EMC Directive 2014/30/EU as amended (“EMCD”), Radio Equipment Directive 2014/53/EU as amended (“RED”)
Harmonized Standards Used, as referred to in: EMCD: EN 61000-6-4:2007/A1:2011, EN 61000-6-2:2005/AC:2005 RED: ETSI EN 301 489-1 V2.2.3 (2019-11), ETSI EN 301 489-17 V3.2.4 (2020-09), EN 55032:2012
Other Technical Standards Used: EN ISO 12100:2010, EN 60204-1:2018, EN IEC 62133-2:2017, EN IEC 60825-1:2014/A11:2020
Boston Dynamics shall transmit relevant information about the partly completed machinery in response to a reasoned request by the national authorities. The method of transmission will be a digital format to be agreed upon with the national authority at the time of the request. This transmission of information is without prejudice to the intellectual property rights of the manufacturer.

Authorised Representative
Jason P. Fiorillo, Chief Legal Officer
Waltham, MA (USA) June 13, 2023

7.2. Labels

The following labels and nameplates appear on Spot. Labels are located inside the battery compartment and are visible before installation.

The year of production is the first digit of the serial number (S/N) following “BD-”. For instance, the serial number BD-3####### indicates a Spot produced in 2023.

SPOT® ROBOT
Boston Dynamics
P/N:
S/N:
WARNING:
Only for use with Boston Dynamics Spot Battery and Charger.
User Guide: Contact support@bostondynamics.com
Patent Information: www.bostondynamics.com/patents
Contains FCC ID: 2AG87ACM-DB-2M-R2 IC ACMDB2MR2
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
CAN ICES-03(A)/NMB3(A)
DESIGNED BY BOSTON DYNAMICS IN MASSACHUSETTS. MADE IN USA
200 Smith Street, Waltham, MA 02451 USA
Boston Dynamics
WARNING: Use only with Boston Dynamics Battery and Charger
当該機器には電波法に基づく、技術基準適合証明等を受けた特定無線設備を装着している。
EU Authorized Rep: Alura, Kroonwiel 2, 6003 BT Weert, The Netherlands
MADE IN USA 200 Smith Street, Waltham, MA 02451 USA
R-NZ
R-R-BDi-4-00143531-001
210-155198
TA-2021-1635
APPROVED
Complies with IMDA Standards DA105282
04-00385327-001

Spot nameplate & label.

8. Appendix A: Supplemental information

Additional information and resources about Spot are available online at the following URLs:

Resource	Section	URL
Spot Power Supply Information for Use	2.9.2.1 4.3.2	https://support.bostondynamics.com/s/spot-product-safety
Spot Dock Information for Use	2.9.2.1 4.3.2 4.4 5.6	https://support.bostondynamics.com/s/spot-product-safety
Spot Arm Information for Use	4.2.1	https://support.bostondynamics.com/s/spot-product-safety
Site readiness for Spot operation	2.9	https://support.bostondynamics.com/s/article/Creating-a-Spot-friendly-environment
Payload Developer Guide	4.2	https://dev.bostondynamics.com/docs/payload/readme
Electrical Interface	2.5.2 4.2	https://dev.bostondynamics.com/docs/payload/robot_electrical_interface.html
Payload configuration requirements	4.2	https://support.bostondynamics.com/s/article/Payload-configuration-requirements
Spot tablet configurations	5.2.1	https://support.bostondynamics.com/s/article/Spot-controller
About the Spot Industrial Inspection Package	5.2	https://support.bostondynamics.com/s/article/scout-inspection-solution-architecture
Scout Administration and Settings	5.2 5.8.1 5.8.2 5.8.3	https://support.bostondynamics.com/s/article/Scout-Administration-and-Settings

Resource	Section	URL
Scout Operator controls	5.3.3 5.7.1 5.7.2	https://support.bostondynamics.com/s/article/Preparing-your-virtual-control-room-for-robot-operation
Transfer an Autowalk Mission to Scout	5.8.1	https://support.bostondynamics.com/s/article/Preparing-Autowalk-missions-for-use-in-Scout
Running Autowalk Missions via Scout	5.8.1 5.8.2 5.8.3 5.8.5	https://support.bostondynamics.com/s/article/Running-Autowalk-Missions-via-Scout
Getting started with Autowalk	5.5 5.7.2 5.7.3 5.8	https://support.bostondynamics.com/s/article/Getting-Started-with-Autowalk
Creating robust Autowalk missions	5.7.3 5.8.3	https://support.bostondynamics.com/s/article/Creating-a-robust-Autowalk-mission-framework
Preventative maintenance for Spot	6.2	https://support.bostondynamics.com/s/article/Preventative-maintenance-for-Spot
Recalibration with SpotCheck	6.3	https://support.bostondynamics.com/s/article/Recalibration-with-SpotCheck
Spot Battery air shipment	3.3.1	https://support.bostondynamics.com/s/article/Battery-Air-Shipment-Guidance